

THE ADVENTURE OF FINDING OUT

INSIDE-

Nº6

30p

World of Knowledge

EVERY WEDNESDAY

Week ending 1st March 1980

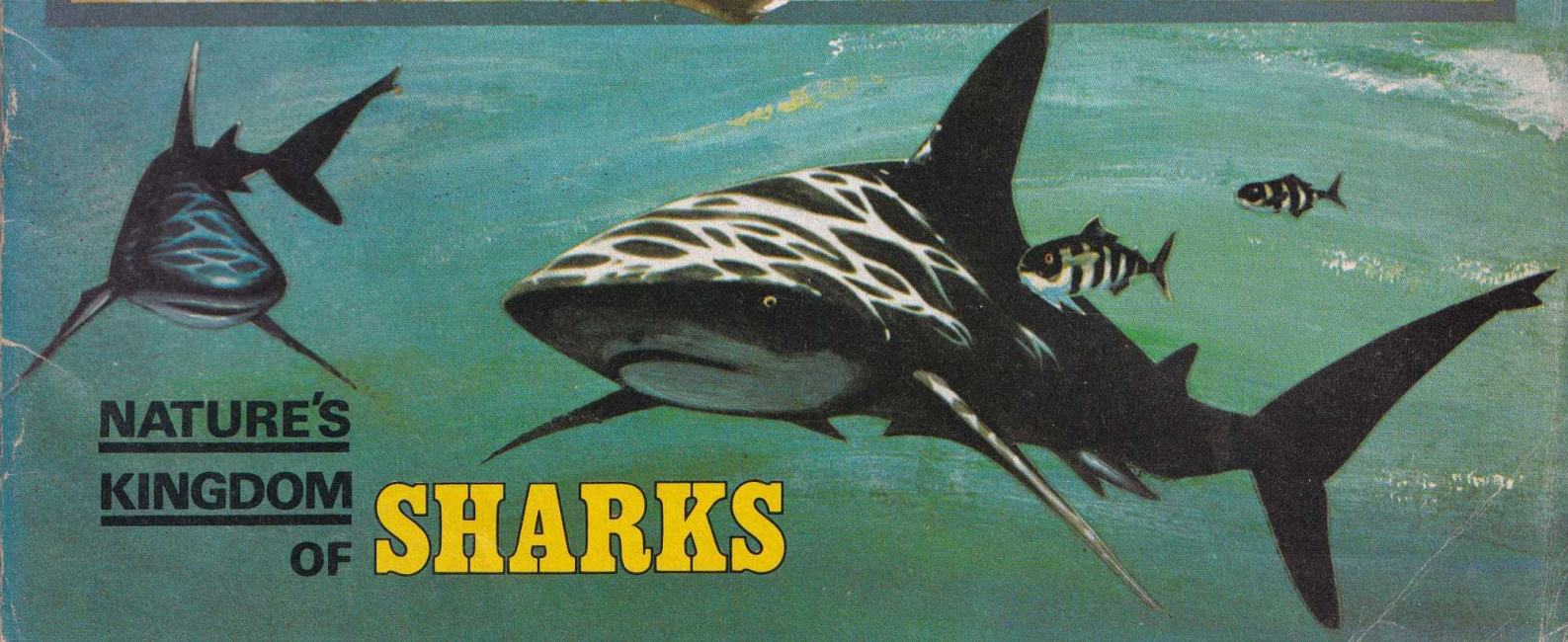


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THE DAY THAT CHANGED THE WAR



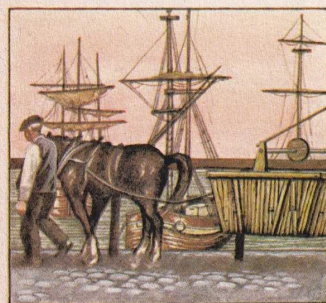
**NATURE'S
KINGDOM
OF**

SHARKS

THIS MODERN AGE

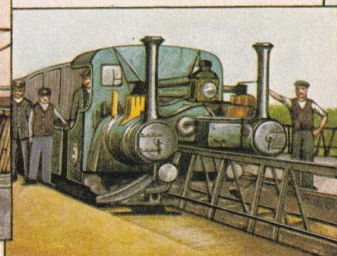
The Monorail dream

For 150 years, railways designers have cherished an ideal — high speed trains which zoom along on single rails. But dreaming up a monorail system is easier than building one.



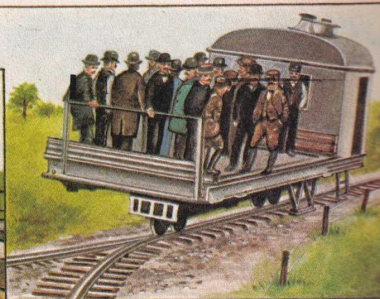
Palmer's Mono Railway

H.R. Palmer's mono railway was extremely simple — a plank on its edge supported on top of stakes set in the ground. The wagons were in two halves, one half on either side to balance them and the wheels (probably ships' pulley wheels originally) in a suitable supporting framework. It was designed initially to transport goods from the dockside to the warehouses nearby. At first, the wagons were manhandled, but soon horses were introduced. Palmer patented the system in 1821 and later proposed fitting it with a sail but this proposal does not seem to have been followed up.



Lartigue's Mono Railway

Frenchman Charles Lartigue patented a strange monorail system, originally intended to provide a light, cheap railway across a plantation. It could be lifted and relaid in a new area quickly and easily. In this form, it was horse-drawn. Lartigue developed it for steam haulage and used it on the Listowel and Ballybunion Railway, built in Ireland in 1902. The track ran on an 'A' frame, the weight being taken by the top rail with the vehicles being balanced by a light rail on either side. The railway was closed in 1924 and dismantled shortly afterwards.



The Brennan Mono Railway

Brennan's system was the only true monorail way ever devised. The vehicle's top speed was 35 kph (22 mph). It was propelled by one petrol motor and balanced by two heavy gyroscopes driven by another motor. It was intended originally as a quick, convenient system with a very light track which the Army could lay from its supply bases to the battlefield. Demonstrated at Gravesend in Kent in 1909, it was hailed as an invention with a great future but interest in it disappeared thereafter and so did the system. Shortly afterwards, similar systems were invented in Germany and Russia.

The greatest problem when designing a monorail system has always been balancing the train and making it stable.

In 1821, H. R. Palmer built what is believed to be the first mono railway — powered by horses! It was used in the London Docks. It was not fast but it was cheap to build and maintain.



The principle used by Palmer was to balance the load by designing the wagons along the lines of the panniers slung across a packhorse's back.

This worked quite well when the wagon was horse-drawn and slow, but when horses were replaced by engines and movement was speeded up, difficulties arose. Inventors began to put steady tracks on either side of the monorail. This worked well on a number of light railways, the most famous of which was the Listowel and Ballybunion Railway in Ireland. But, of course, once the

The train which floats on air

The most exciting monorail projects for the future are not monorails in the ordinary sense because the carriages have no wheels and they do not run on a track. Instead, they float above the track and travel along it without friction at speeds that would be impossible using wheels.

The first of these 'flying trains' was designed by Eric Laithwaite, Professor of Heavy Electrical Engineering at London's Imperial College of Science and Technology. The train was to be 'supported' by magnetism. Everyone knows that two bar magnets will fly apart if placed north pole to north pole or south pole to south pole and Professor Laithwaite's first plans were based on this magnetic repulsion which can be used to lift a train above the ground. He eventually decided it would be better to adapt the Hovercraft principle, so he designed a series of Hovertrains.

No moving parts

His Hovertrains floated above their tracks on a cushion of air and were driven by an electric motor that had no moving parts. Instead, the carriage was fitted with electromagnets energised by electricity picked up from the live rail while the entire track formed a long electromagnet that was magnetised bit by bit so that the Hovertrain was pulled forward. The 'motor' is called a 'linear induction motor' and can move trains at speeds up to 800 kph.

The system worked well in scale models and there was even a full-size demonstration, but the project was not fully developed because there were not sufficient research funds available.



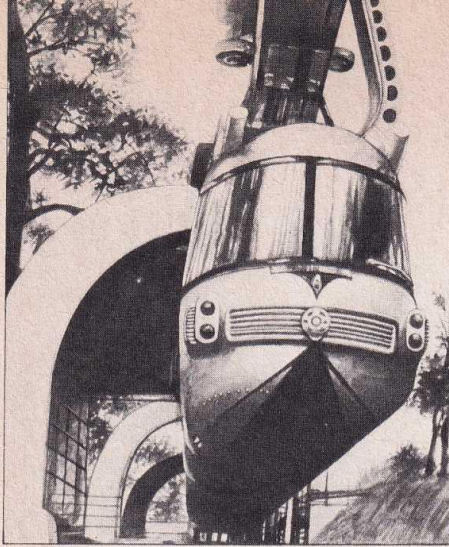
The Kearney High-Speed Railway

Kearney's monorail car was designed to run on a single weight bearing rail while being kept in an upright position by an overhead guide rail. Great plans were suggested to use the system above, on and under the ground. An almost full-size model was built and exhibited but no investment money was forthcoming so the idea died and with it went Kearney's plans for a massive commuter system for London.

The Wuppertal Mono Railway

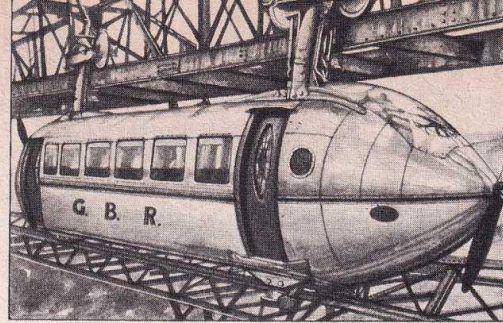
Started in 1901 and running profitably until quite recently, the Wuppertal monorail (right) was probably the most successful system built to date. The line, which straddled the River Wuppertal in Germany, provided a steady and reliable passenger service between two towns. The coaches, suspended from electrically-driven trolleys, travelled at an average speed of 24 kph (15 mph).





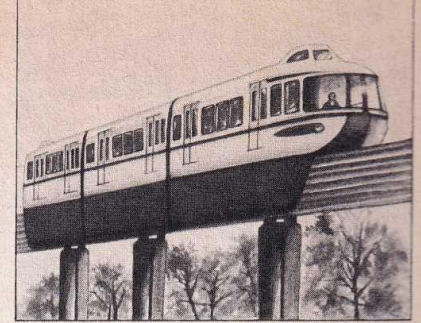
The Tokyo Mono Railway (above)

This suspended monorail was set up, as an experiment, in a park in Tokyo in 1957. Difficulties were experienced with the suspension and when later, it was decided to build a mono railway from the airport to Tokyo, the Alweg System (see right) was chosen. The Alweg railway runs from Haneda Airport to Hamamatsuchō station, a distance of about 16 km, taking 15-20 minutes.

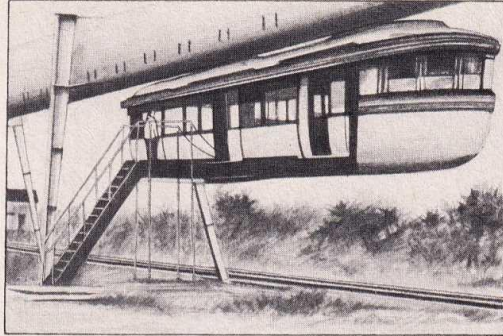


The Bennie Railplane and the Alweg System

The Bennie Railplane (above, left) was designed for high-speed travel. Electrically-powered airscrews drove the cars which hung from an overhead line and picked up current from a guide rail below. An experimental track was built in

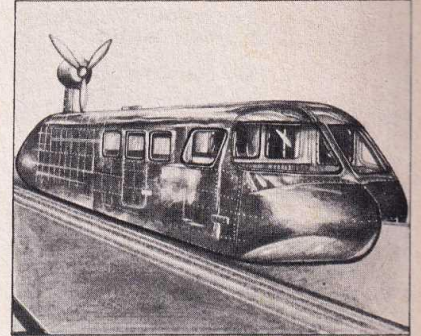


Glasgow in 1930. Dr. Axel Wenner-Gren's Alweg system (above, right), although classified as a monorail, runs on a massive concrete beam. The cars are fitted with pneumatic-tyred wheels which run on top of the beam.



The Safege System and the Bertin Aerotrain

The French Safege system (above, left) uses a tube with a slot along the bottom. The car hangs from this tube by means of wheels which run along inside it on pneumatic tyres. The idea is to protect the track and machinery from the weather, but the running gear tends



to overheat. The Bertin Aerotrain (above, right) was an air-cushioned hovertrain, running on an inverted T-shaped track. The cars were powered by an airscrew. High costs caused the project to be abandoned.

steadying rails were introduced, the lines ceased to be true monorail systems.

The simplest way to keep vehicles steady when they run on a single line is to hang them *below* the track. A number of inventors have designed railways of this kind. The outstanding example is the Barmen and Elberfeld Railway in Germany, invented by Eugen Langen, and which is today the classic example of a successful public mono railway.

But the most exciting kind of mono railway consists of a single line along which streak streamlined, gyroscopically-stabilised coaches. A space age idea for the future you might say. But you would be wrong. A gyro-car was patented in 1903 by Louis Brennan, an Irish engineer from County Mayo, who built a remarkable vehicle which ran on two

two-wheeled bogies. Although it was shown in Europe and America, it came to nothing.

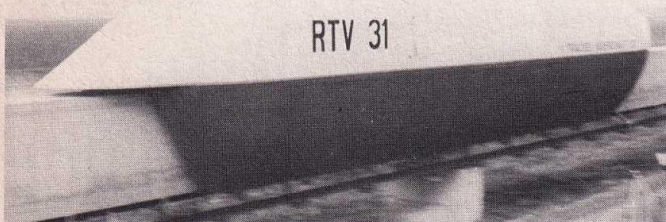
Despite its long history and all the apparent advantages it offers today's world, the monorail has literally never 'got off the ground'. Monorails are so utterly different from conventional railways that few people will take the risk of investing money in them. They cannot, for instance, be integrated into normal railway systems, but can only supplement them. They can carry only passengers and lightweight freight — and, in the past, much more money has been

made on heavy freight. At present, for economy's sake, they are really suitable only for straight runs without sidings or branch lines.

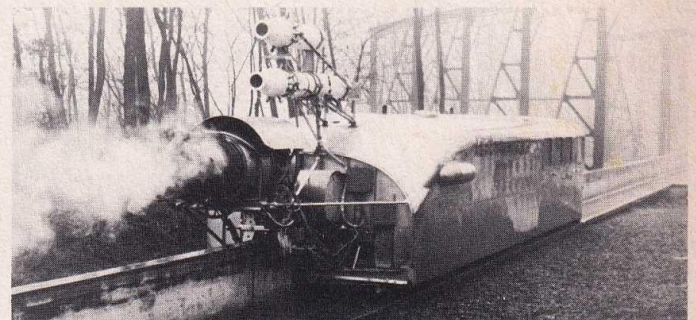
So what of the future? The increasing shortage of land in the world's cities may force authorities to use the monorail for some town and suburban routes. Research goes on constantly with both working models and prototypes such as a short line in Tokyo and several within American airports.

So the monorail still remains an exciting and challenging possibility to the railway designers of the world.

The British and French Hovertrains — two recent non-starters!



Claimed to be the world's first electric hovertrain, the British monorail, or beam-rail, was made to hover magnetically and was propelled by a linear induction motor. After several years of encouraging development, including test runs on a demonstration track at Earith, Huntingdonshire (above, left), the project was abandoned because of increasing costs, and limited prospects. This type of rail-



way can only pay for itself if it is run between two places which can provide sufficient passengers to ensure full coaches on all runs. The French hovertrain (above, right) was developed to use jet engines to increase its speed. On a concrete circuit, the car achieved 375 kph but the performance was not sufficient to ensure its development and yet another monorail project died.

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A MAGNIFICENT WALL
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**Great Explorers
of the World**

EVERY MONDAY . PRICE 1/6d . No 1 . 28th MARCH 1970

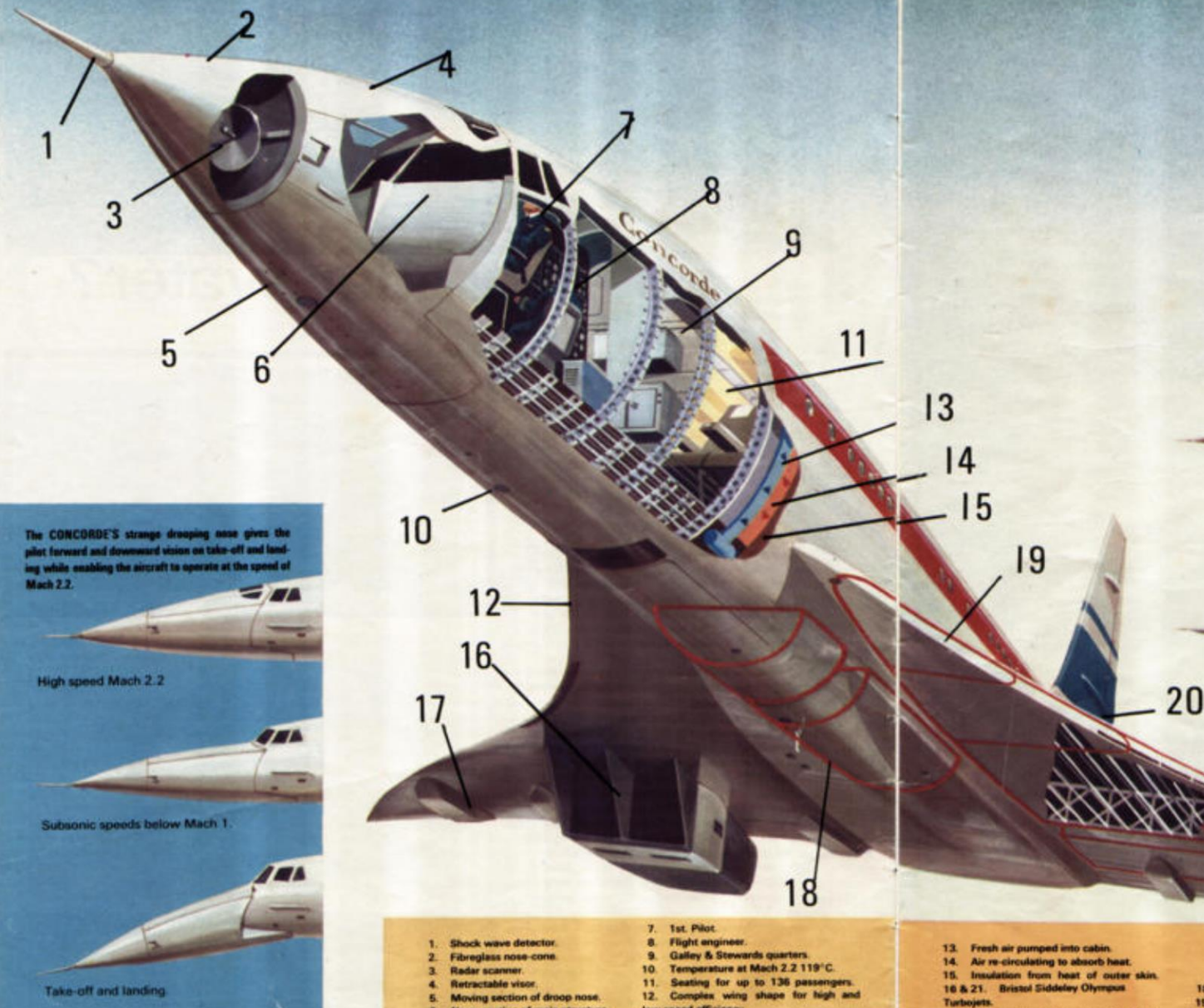
Eire 1/10d Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 2/4d E. Africa 2s 50 W. Africa 2/0d Malaysia 80c Malta 1/9d

**THE VIKINGS
ARE COMING!**

See page 18



TWICE AS FAST AS A BULLET!



The CONCORDE'S strange drooping nose gives the pilot forward and downward vision on take-off and landing while enabling the aircraft to operate at the speed of Mach 2.2.

High speed Mach 2.2

Subsonic speeds below Mach 1.

Take-off and landing.

1. Shock wave detector.
2. Fibreglass nose-cone.
3. Radar scanner.
4. Retractable visor.
5. Moving section of droop nose.
6. Nose section of main structure.
7. 1st Pilot.
8. Flight engineer.
9. Galley & Stewards quarters.
10. Temperature at Mach 2.2 119°C.
11. Seating for up to 136 passengers.
12. Complex wing shape for high and low speed efficiency.

13. Fresh air pumped into cabin.
14. Air re-circulating to absorb heat.
15. Insulation from heat of outer skin.
- 16 & 21. Bristol Siddeley Olympus Turbojets.
- 17 & 20. Fairing over control surface operating gear.

18. Fuel tanks.
19. Wing fuel tanks.
22. Surface sprayed with a special toughened paint to resist heat.

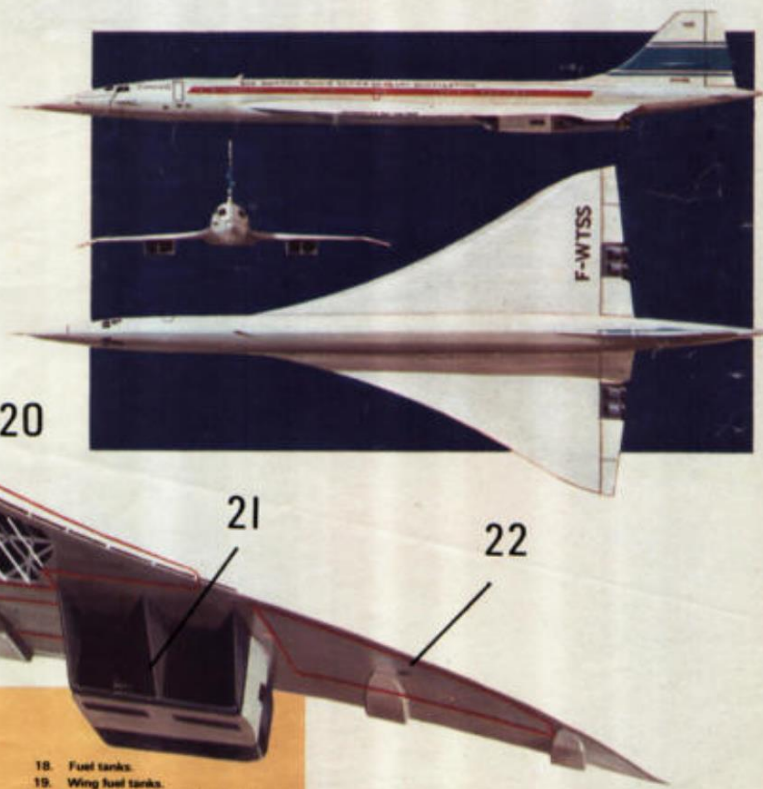
When a man squeezes the trigger of a rifle the bullet leaves the barrel at 800 m.p.h.

Concorde, the world's first supersonic jet airliner, being built by Britain and France, will fly at almost twice that speed.

Concorde's speed is described in engineering terms as "Mach 2.2". "Mach" means the speed of sound at sea level, which is 750 m.p.h.

Mach 2.2 is, therefore, 1,500 m.p.h. at 60,000 feet, the height at which Concorde will fly.

Concorde, which will carry more than 100 passengers, has a pointed nose visor which is raised in supersonic flight and lowered for take-off and landing, so that the pilot has normal forward vision. It is powered by four Bristol-Siddeley Olympus Turbojet engines.



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**EXCITING
STORIES
ABOUT OUR
EXCITING
WORLD**

EVERY MONDAY . PRICE 1/6d . No. 3 . 11th APRIL 1970

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COUSTEAU-KING OF THE DEEP

A Name To Remember
Story: Page 30

It was shaped like a needle—this tiny plane that first pricked the fringe of space.

PROJECT

X-15



Forty-five thousand feet above the mountains of Nevada, in America, a huge B-52 bomber sped through the upper layers of the Earth's atmosphere at over 600 m.p.h. Tucked under its starboard wing was a tiny needle-shaped aircraft—the X-15 rocket plane.

Inside the cramped cockpit a test pilot watched his control panel. As all his warning lights flashed green, the X-15 dropped away.

Seconds later, its liquid-fuelled rocket engine burst into life, and half a million horse-power thrust the plane into space at almost 4,500 m.p.h. Within 80 seconds its eight tons of fuel were exhausted, but the X-15 continued to climb until it was 67 miles above the surface of the Earth.

Then began the most difficult task of bringing the X-15 back in a long engineless glide. Re-entering the Earth's atmosphere at too steep an angle, it would have burned up like a meteorite. Coming in at too shallow an angle, it would have travelled so far that it could not have regained the airfield. Thanks to the skill of the pilot and others like him, the X-15 landed safely.

Project X-15 began as long ago as 1953, and experiments were continued into the 1960s. A great deal was learned from them about how to control space vehicles in the airless region above our planet.

Without the work done by Project X-15, Man could never have realised his dream of reaching the Moon and setting foot upon it.

KEY

1. LR-99 oxygen/ammonia reaction motor.
2. Ceramic-lined nickel tubes.
3. Flame shield.
4. Fuel jettison tube.
5. Fuel tank air vent.
6. Lower rudder jettisoned by explosive bolt.
7. Combined aileron-elevator.
8. Skid (shown dotted in illustration at top of facing page).
9. Multi-spar box construction.
10. Control jet nozzles for use above Earth's atmosphere.
11. Hydrogen-peroxide tank.
12. Nose-wheel.

13. Electrically-heated nose probe.
14. Control jet nozzles in top, sides and underside of nose.
15. Instrument panel.
16. Rocket-boosted ejection seat with all life support systems, stabiliser fins, anti-blast shield.
17. Instrument bag.
18. Colour cine-camera recording journey.
19. TV Camera.
20. Accessory power unit. The X-15 was above the atmosphere for most of the time.

21. Liquid nitrogen tank.
22. Liquid oxygen tank.
23. Anhydrous ammonia tank.
24. Hydrogen-peroxide tank.
25. Moving rudder.

Dimensions: Length: 50 ft.
Span: 22 ft.
Height: 13 ft.
Wing Area: 200 sq. ft.
Weights: Empty: 16,000 lb.
Launched: 31,275 lb.

Landing Speed: 205 m.p.h.
Top Speed: Mach 7.1
Max. Height: 250,000–350,000 ft.

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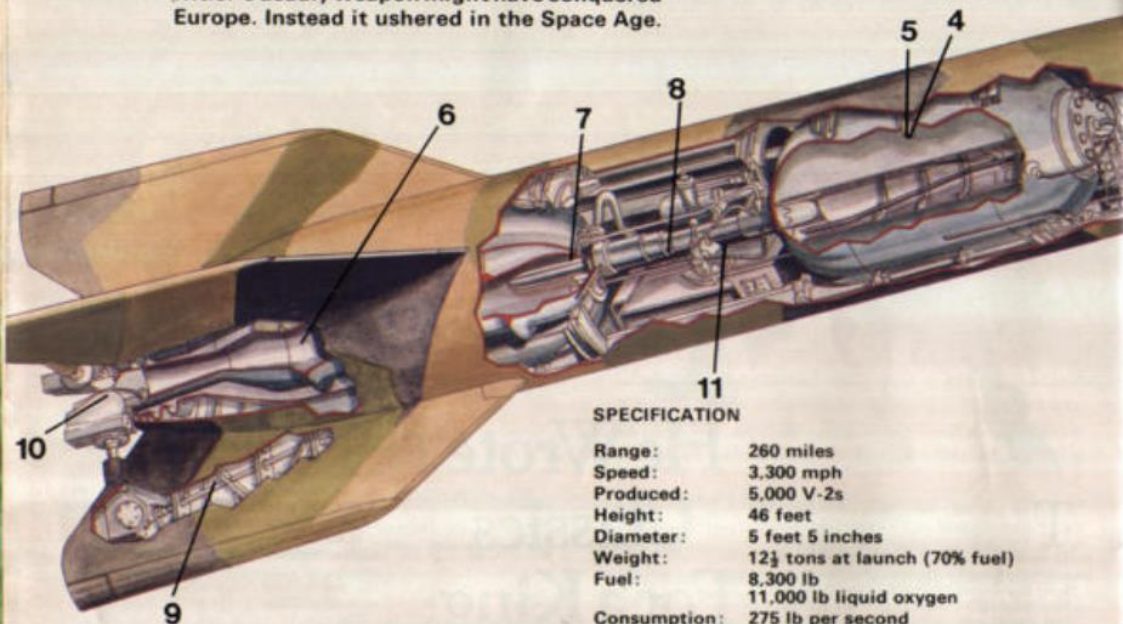
The End of
Anglo-Saxon
England

Story: page 23



The Terrifying V-2

Hitler's deadly weapon might have conquered Europe. Instead it ushered in the Space Age.



SPECIFICATION

Range:	260 miles
Speed:	3,300 mph
Produced:	5,000 V-2s
Height:	46 feet
Diameter:	5 feet 5 inches
Weight:	12½ tons at launch (70% fuel)
Fuel:	8,300 lb
Consumption:	11,000 lb liquid oxygen
Exhaust gas velocity:	275 lb per second
Control system:	6,950 feet per second
	Cybernetic servo-system with graphite vanes

Just as people in Britain were hoping that the Second World War might soon be over, a new and menacing weapon began to speckle the skies above them.

In a desperate attempt to stave off defeat, Hitler had developed a rocket-propelled warhead which streaked across the Channel and struck terror into the civilian population.

There would be a noise like an express train in the sky, and down on London would descend another of Hitler's V-2 rockets.

Little could be done to halt these deadly rockets; and the fear grew that they might yet help Germany avoid the final defeat.

As it was, Hitler himself was not entirely convinced that a pure rocket was more effective than a rocket-powered aeroplane. The Luftwaffe (German Air Force) said that because it was a complete weapon with its own propulsion and warhead, it was the concern of the German army. And the German army wanted nothing to do with it, saying that it was an aerial weapon and therefore the responsibility of the Luftwaffe.

Thanks to this confusion, there was a long delay in mass production of the V-2, and only 1,000 were fired before the eventual Allied victory restored peace in Europe.

However, the importance of these German advances in rocket technology had been recognised, and at the end of the war much of the rocket material and equipment was taken to Britain, the U.S.A. and Russia.

At the same time, a brilliant German scientist named Wernher von Braun joined the Americans of his own free will, so that he could continue the work he had already done on rocket propulsion.

Years later, his genius helped man to realise one of his greatest dreams—leaving this planet and travelling through space.

It was only because Von Braun lived in Germany that he received any encouragement in rocket research. Most countries had not bothered because of lack of funds. Germany did have one government department which continued to examine the possibilities.

When the prospect of war looked like becoming real in 1935, they received orders to develop a rocket capable of delivering a ton of high explosive on London or Paris from Germany. It had to be accurate, undetectable, and able to reach its target without the enemy being able to stop it—an incredible feat in the late 1930s.

Scientists worked on problems of guidance systems, gyroscopes, fuel pumps, fuel turbines, steam generators and the rocket motors themselves.

A series of rockets called the A1, A2 and A3 was built and tested at a site on the Baltic Sea called Peenemünde, where Von Braun was the technical director. Gradually the problems were overcome, but only after many unnerving incidents.

The next rocket was the A4, which we know better now as the V-2 (revenge weapon No. 2). The first two crashed and exploded, but number three was a great success. On 3rd October, 1942, it flew to a height of 50 miles and landed 119.3 miles away, right on target. The age of the rocket had been born.

Fortunately, because of German staff blunders, the V-2 never succeeded in terrifying Europe into submission. But it had taken the first step into the space age.

After 1945, Wernher von Braun's work on rockets went ahead in America—and a comparison in size between the early V-2 and the Saturn V shows just how enormous the strides forward have since been.

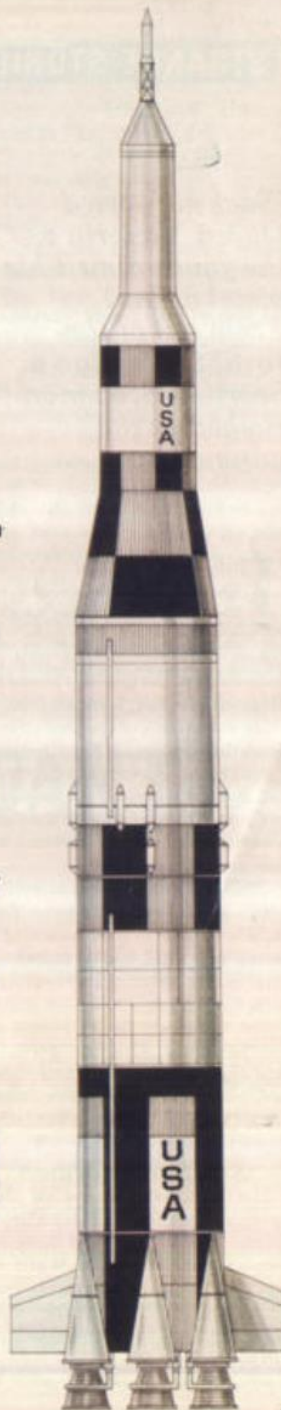
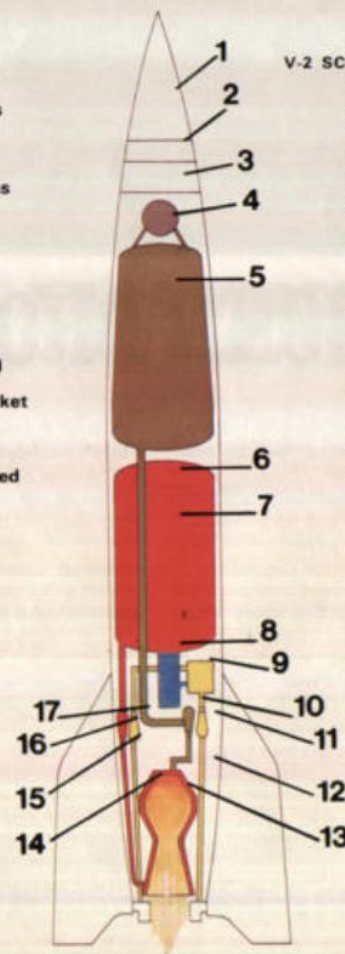
THIS IS A LATE PRODUCTION VERSION OF THE V-2.

1. Warhead
2. Guidance systems
3. Gyros
- 4/5. Tank within a tank. Alcohol and oxygen tanks built as integral unit
6. Combustion chamber
7. Igniter
8. Injectors for fuel
9. Control vane actuating rod (one in each fin)
10. Graphite control vanes. These turn slightly, making rocket go in direction required
11. Turbines and injectors for fuel feed to combustion chamber

V-2 SCHEMATIC ILLUSTRATION

1. Warhead
2. Guidance systems
3. Gyros
4. Helium to prevent oxygen and alcohol from exploding
5. Oxygen tank
6. Alcohol tank
7. Oxygen feed pipe
8. Hydrogen-peroxide tank
9. Steam generator for turbines
10. Turbine driven pump
11. Steam turbine
12. Steam outlet pipe
13. Igniter and combustion chamber
14. Fuel coolant (alcohol, which is heated in jacket round combustion chamber)
15. Alcohol heater inlet pipe
16. Turbine driven pump
17. Steam turbine

The V-2 rocket (left) was 46 feet in length, while the Saturn V (right) which took Man to the Moon was eight times longer—365 feet.



Take a Piece of Africa, the Island of Newfoundland, and the Bay of Biscay and you've got . . .

THE WORLD'S BIGGEST JIGSAW PUZZLE

Do you like jigsaw puzzles? Do you sit trying to fit the pieces so that when you have finished you have a complete picture?

If so, you may look at the map on these pages and arrive at the same picture as Alfred Wegener did fifty years ago.

The German scientist worked out the biggest jigsaw puzzle in the world.

He looked at the map and saw how the north west bulge of Africa would fit neatly into the hollow between North and South America; the island of Newfoundland would occupy the Bay of Biscay; the west coast of Canada would be a perfect match for the west coast of Ireland.

The answer's obvious, thought Wegener. North America and Europe were once joined together. South America and Africa were one great land mass.

His theory got little support from other scientists. Sheer coincidence, they thought. But, in recent years, explorations have been carried out that make it almost certain that Wegener was right.

Let us take a look at the Atlantic sea bed. Imagine we are on the shore facing the sea. If we start walking towards the water, the beach will slope gently away from us until it vanishes beneath the waves. If we could continue walking, we would find that the slope continues far out to sea.

Suddenly we would come to an abrupt drop, the ground falling sharply away from us. In some places it would be like the side of a mountain; in others as sheer as a wall. The depth of this mountainous drop may be anything between two and five miles.

At the bottom, the ground flattens out again. But if we kept on walking we would reach great mountain ranges, high ridges, deep trenches and gullies.

In some places, the tips of the mountains rise thousands of feet to make islands such as the Azores or Tristan da Cunha; in others, gaping trenches fall more than five miles into the black void.

We know all this from the work of scientists during recent years who have been mapping the bottom of the Atlantic by means of echo-sounders (see page 7). They can now provide a complete picture of the sea bed.

The first area of the sea bed, that part that slopes gently from the shore, is called the continental shelf. It is, in fact, part of the continent, a part that is now under water but which was probably dry land millions of years ago.

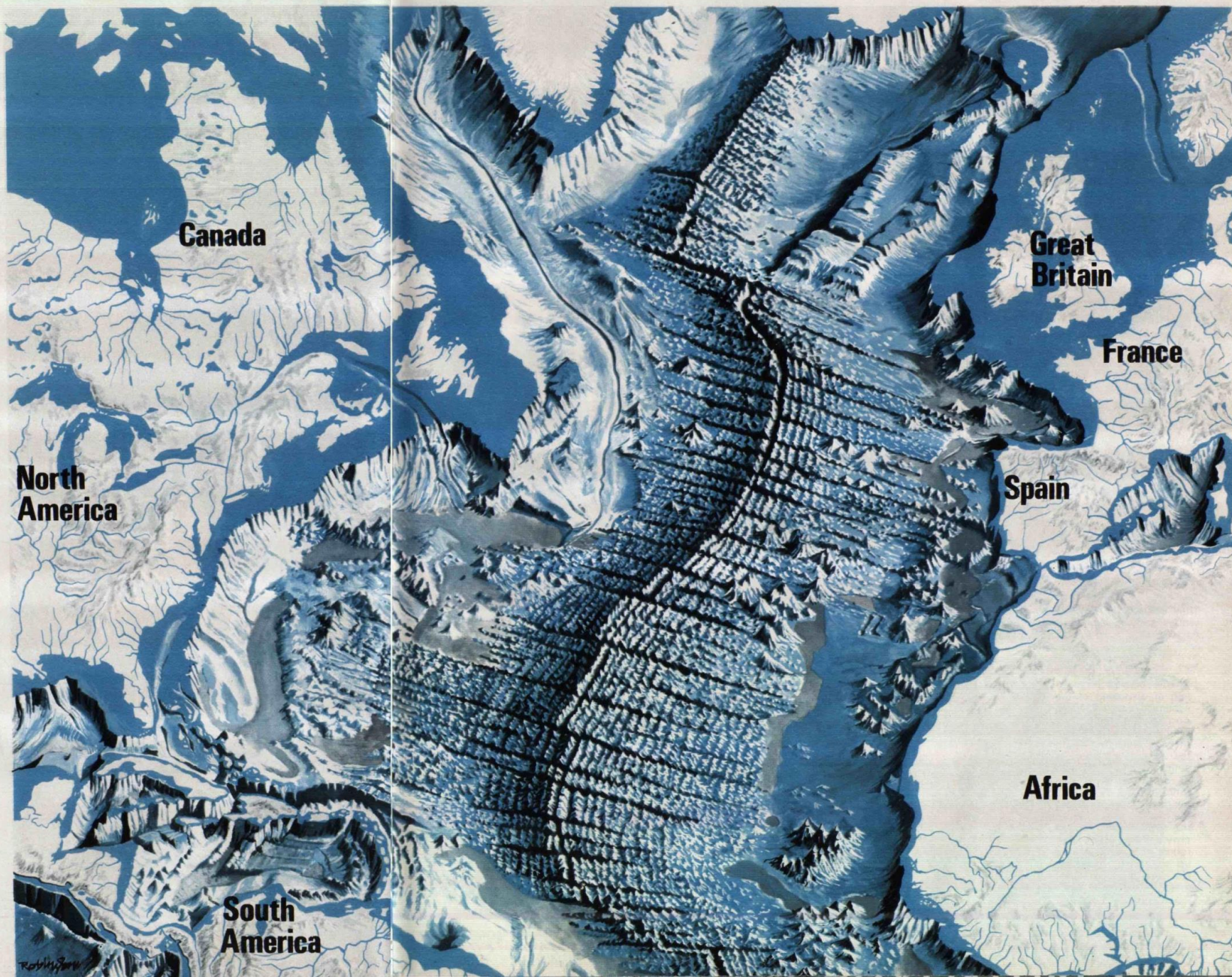
The width of the continental shelves vary in width from thirty miles to several hundred miles. And it is the shelves that prove Wegener was right. If we place the edges of the shelves together, rather than the continents themselves, they match so exactly as to rule out the possibility that they were not one great land mass joined together.

Only three years ago, geologists discovered layers of rock in Brazil which exactly matched the layers of rock in the bulge of Africa. The pieces of the jigsaw fitted exactly.

But if the four continents were once all joined together how did they come to be separated? The oceanographers mapping the sea bed may have provided the answer to that too.

Running the whole length of the North and South Atlantic is a huge range of mountains, 10,000 miles long. Everything suggests they were formed by a great volcanic eruption, a sort of 'hiccup' that we mentioned in World of Wonder No. 3 in discussing the formation of the Alps.

It is more than likely the "hiccup" followed a line along a weak spot in the earth's surface, tearing the land in two and forming the continents as we know them today.



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SHOOT to SAFETY

Page 8: The story of the ejector seat.



For centuries Jewish people had been outcasts in the world. But on a May afternoon in 1948, their long-cherished dream came true. In their promised land they made . . .

A NATION OF THEIR OWN



Herzl

On 2nd October, 1917, Lord Balfour, the British Foreign Secretary of the day, announced what is known as the Balfour Declaration. It meant the realisation of a dream that the Jewish people had held for almost 2,000 years.

Simply it stated that *His Majesty's Government views with favour the establishment in Palestine of a national home for the Jewish people . . .*

Those words echoed the age-old longing of Jews, scattered among the nations of the world, who yearned for a country they might call their own.

But for the Zionists, those who cherished the notion of returning to the ancestral soil of Israel, this was neither the beginning nor even the end of a long and dramatic chapter of history.



● **ZIONISM**—the cause that gave hope to the Jews.



Weizmann



Balfour



Ben Gurion

● **NAZISM**—the cause that tried to destroy them.





Though the Jewish people settled in a territory that was little more than a wilderness, they have spared no effort to turn it into a modern and productive land. Mindful of the future, they have seen to it that their young people are well educated—and the Hebrew University in Jerusalem, built in 1954, bears favourable comparison with any university in the world.

The old traditions have not been neglected, however. Religion still plays an important part in the Jewish way of life. A time-honoured ceremony is performed in the photograph below. A *shofar*—a ram's horn—is blown in front of Migdal David (Tower of David) to herald in the Jewish New Year. This is blown 100 times, and is based on Abraham not sacrificing Isaac—hence the use of the ram's horn.



Zionism, as a political movement, was born in the 19th century. At that time many Jews in Europe were persecuted and deprived of their civil rights. Many had no vote. Others were forced to pay excessive taxes.

In many European countries Jews were treated as second-class citizens, and although they contributed to trade and commerce they were still often regarded as 'aliens' in the countries where they had made their homes.

Not every Jew was a Zionist. Indeed, a number feared that if Zionism managed to achieve its objective and create a Jewish home, then they might be forced to go there, wherever it might be.

Certainly at the turn of the century it seemed unlikely, whatever home was eventually created, that it would be Palestine itself. That country was ruled by the Ottoman empire, as it had been since 1517.

Run-down and neglected, it was no land flowing with milk and honey. It was rather a country of

swamps and dunes and arid desert.

Although the British Foreign Office had approached the Turks with a view to obtaining a charter for the formation of a company 'to develop the material resources and administration of Palestine' these advances had met with no response. And, although there were some 24,000 Jews living in Palestine in 1882, the likelihood of the Turkish Government allowing full-scale immigration was remote.

Nevertheless, that year saw the arrival of the first 'modern' settlers. Russian Jews, fleeing from Tsarist massacres, founded farming communities in Palestine, and slowly, amid the malaria-ridden swamps, small islands of cultivation sprang up.

Undoubtedly the presence of these people was illegal, for permission could not be obtained from the Turkish Government, but by 1897 there were 18 flourishing Jewish settlements in this neglected corner of the Ottoman empire.

However, it was clear that if the Zionist dream was ever to become a

reality—and if a Jewish state was to be established in Palestine rather than on an island in Niagara or in Argentina (two proposals that had been put forward)—then it would require a world-wide movement to achieve it.

The man who sparked that movement into life was Theodore Herzl, a Hungarian Jew born in Budapest in 1860. Moving to Paris, where he became a leading journalist, he campaigned vigorously for the restoration in Palestine of a Jewish state. Herzl was a visionary, and some dismissed him laughingly as 'the Jewish Jules Verne'.

However, another leading Zionist, Chaim Weitzmann, a scientist at Manchester University, liked Herzl's style and saw in him the man of action that the hour demanded.

Herzl worked ceaselessly. At first he approached leading Jewish families like the Rothschilds for help, but then he decided the only hope was to appeal to the masses. He determined to call together a World Jewish Congress.



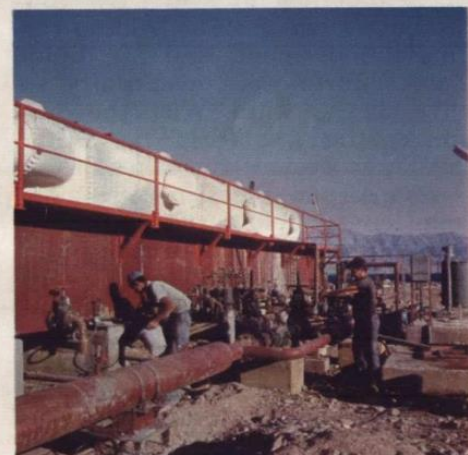
Everyone in Israel contributes to the benefit of the community as a whole. An important feature is the *kibbutz*, where people live in communities, pooling their resources to make the land thrive. (Left: pomegranates being grown on a kibbutz.) All young people, even girls, are also trained as soldiers for the defence of their country.

Due largely to Herzl's own efforts, on 29th August 1897, the first Jewish Congress met in Basle. Among the 197 delegates who attended were representatives from England, America, Algeria and no less than 70 to speak for the five million Jews of Russia.

At the time, there were some 10½ million Jews in the world, and a mere handful in Palestine itself. Would that situation ever alter? Could it be altered?

If enthusiasm alone could achieve anything, Herzl would surely have triumphed. He had a Star of David flag hung at the Congress, saying: "It is with a flag that people are led whithersoever one desires—even to the promised land"

The Congress itself set up an Action Group to press for the legal recognition of a Jewish homeland in Palestine. Herzl himself sought interviews with European statesmen and sovereigns, and Kaiser



The economic growth and strength of a country lies to a large extent in its mechanisation and industry. This photograph shows a desalination plant near Eilat on the Red Sea.



Sport and recreation, the Jewish people believe, stimulate healthy minds and bodies—and the development of facilities is encouraged everywhere. This photograph is of Horshat Tal, a recreation centre in Galilee.

Wilhelm II promised to take up the Zionist cause with the Turkish Sultan. But it was without result.

Herzl visited Palestine, where he was followed everywhere by Turkish detectives. Eventually, in May, 1901, after a good deal of bribery, Herzl managed to secure an audience with the Sultan. The outcome was disappointing and the Zionists failed to advance their cause.

Three years later Herzl contracted pneumonia and died.

The Jewish Congress continued to meet annually, but Palestine remained within the Turkish empire and the Jewish people seemed no



An aerial view of the Kibbutz Yotvata—one of the large self-supporting settlements scattered throughout Israel.

nearer to their aim of founding a national home.

Nevertheless, Herzl's work was not altogether in vain. By now Chaim Weitzmann was leading the Zionist movement, and his diplomatic efforts were eventually to have their reward. With the outbreak of the First World War in 1914 the Turks became the allies of the Germans, and Palestine itself became 'enemy-held' territory.

In 1917, Lord Balfour, who had first met Weitzmann eleven years earlier and had struck up a cordial relationship with the Zionist leader, issued his famous declaration. Shortly afterwards Lord Allenby led British troops into Jerusalem. The long rule of the Ottoman empire in Palestine was over.

'Modem' Settlers

While the sound of guns echoed around the hills overlooking Jerusalem the foundation stone of the Hebrew University was laid, and Chaim Weitzmann, widely respected by the statesmen of Europe, was virtually a President without a State.

When the First World War ended, there were 55,000 Jews in Palestine, and now more and more settlers began to pour in from Europe.

Life for the pioneers was far from easy. Hundreds succumbed to malaria. Others toiled to plant trees and drain the swamps; to build roads and new settlements. Many went hungry so that they could feed their cattle. "We are Zionists," they joked, "but our cows are not."

Palestine was now under British

rule, but still the question of a Jewish home remained unresolved. What exactly was meant by a 'national home' as suggested by the Balfour declaration?

The interpretation was far from clear, and the issue was further complicated by the growth of Arab nationalism. Arab revolts arose in Egypt, Syria and Palestine itself. Jewish immigration to Palestine was suspended, and relations between the Zionists and the British government deteriorated.

How could the problem of Palestine be solved? How was it possible to satisfy both Jewish aspirations and the Arab world's equally insistent demands for independence and nationhood? In 1937, it was suggested that Palestine should be partitioned. But that idea found little favour with either Arab or Jew.

Green Pastures

By 1939, the number of Jews in Palestine had increased to 450,000. The city of Tel Aviv was growing fast, and in the deserts green pastures were springing up beneath the feet of the Jewish colonists. Yet still no formula had been found to legalise the status of those Jews.

But now Adolf Hitler plunged the world into war again, and for six years Europe became a battlefield. Nazism was finally defeated and Hitler's dream that a 'Master Race' would rule the world was shattered.

But the price of victory was heavy.

Among the victims of that holocaust were six million Jews—one million of them children—ruthlessly exterminated by the Nazis in the most dreadful act of inhumanity imaginable.

News of what had happened in Nazi-occupied Europe stunned the world. When the war ended in 1945, there was both horror and sympathy for the Jewish people and for the cause of Zionism.

World opinion favoured the establishment of a Jewish state in Palestine, and once again Chaim Weitzmann began his international canvassing. The situation had changed vastly since Herzl's early campaigns.

In the United States there existed an influential body of Jewish opinion, and the people of the United States themselves, mindful of their own pioneering birth as a nation, were sympathetic to the Zionist aims.

In 1947, there were 650,000 Jews in Palestine. There were also 1,200,000 Arabs. And to many the fairest solution seemed to be the partition of the country into Arab and Jewish sectors.

So, on 29th November, 1947, the United Nations General Assembly passed by 33 votes to 13 a resolution for the partition of Palestine.

Immediately Palestine was plunged into war. Conflict broke out between the Jews and the Arabs, who opposed partition. Palestine was still under British mandate and until it expired, on 14th May, 1948, the British Government attempted to preserve impartiality.

Independence

Then, on 14th May, Sir Alan Cunningham, the High Commissioner, left the soil of Palestine with his staff, and from a cruiser outside territorial waters he signalled the end of the mandate. At 4 p.m. on the same day, in the Museum of Tel Aviv, David Ben Gurion, read the Proclamation of Independence and became Israel's first Prime Minister.

The State of Israel was born, and the Zionist movement, nourished on a 2,000-year-old dream, given political impetus by Herzl and international recognition by Weitzmann, had laid the foundations for a nation.

Since 1948, Israel and her Arab neighbours have been in a state of war. In the country that was Palestine the battle for peace has still to be won.

WORLD of WONDER

incorporating TELL ME WHY

EVERY MONDAY . PRICE 1/6d . No. 14 . 27th JUNE 1970

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**ON TOP
OF THE
WORLD!**

Story: page 22

Of all the strange fish in the sea, the strangest are not fish at all. They are animals—and not much animal at that. In fact, they are nearly all jelly.

Yes, you have guessed it—they are jelly-fish. These strange animals belong to a family which goes under the Greek name of *Coelenterata*, which simply means "hollow stomachs".

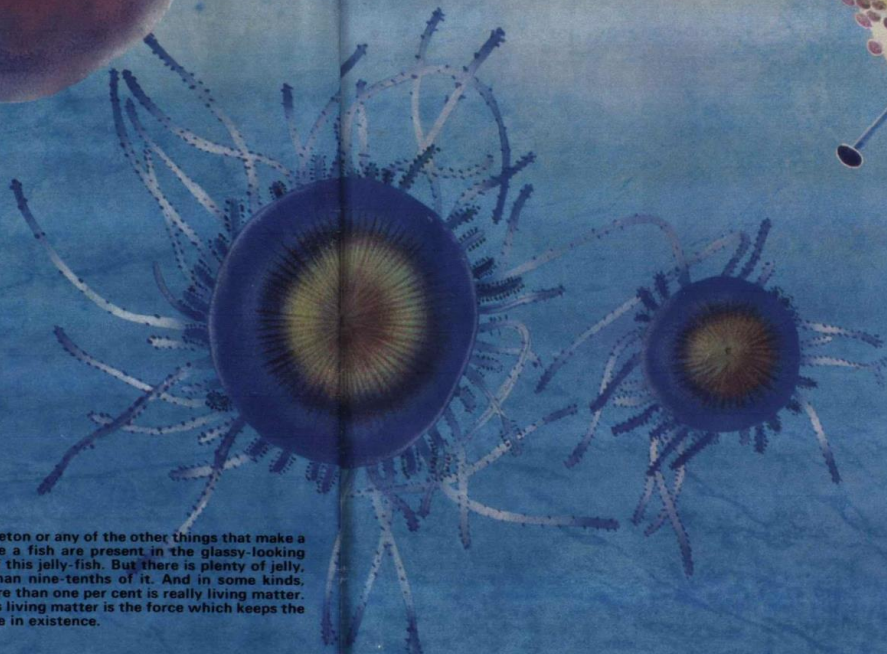
If their name is unusual, so is their way of life. At one stage they are like tiny pods, at another like living plants and at a third like deadly floating umbrellas.

Thousands of different kinds float around the world's seas, killing and eating and reproducing. Some are very beautiful, as you can see from these pictures.

Scientists are fascinated by them and their odd lives, and they have discovered some strange facts about them!



This jelly-fish belongs to the *medusa* family. This is because its tentacles are supposed to make it look like a mythical monster, *Medusa*, whose hair was like snakes. It is the common jelly-fish found around the shores of Europe. Best seen in shallow water, it is able to catch small fish but prefers tiny sea animals.



No skeleton or any of the other things that make a creature a fish are present in the glassy-looking body of this jelly-fish. But there is plenty of jelly, more than nine-tenths of it. And in some kinds, not more than one per cent is really living matter. But this living matter is the force which keeps the creature in existence.



DEADLY UMBRELLAS



With their transparent or pale colours, many jelly-fish are very attractive. At night-time, some can be seen glowing in the sea. Their size varies from smaller than a pea to twelve feet across. Some live in colonies joined to a long stalk which is attached to a large body called the float. This drifts along on or near the surface and supports the rest of the colony.



How can a creature live without a brain? The jelly-fish manages to do so somehow. Muscles on its underside open and close its body like an umbrella as it wafts through the sea. Long tentacles reach out for food to keep it alive. A paralysing stab stuns the minute sea creatures it eats and the tentacles draw these into the mouth below the body.

There is no heart in this jelly-fish or in any other, but it has a large stomach and tiny eyes. And it has tiny sense organs which may be used to help it to balance. Life for the jelly-fish begins when an egg is laid. After swimming about for a while, this settles down on the sea bottom. Shortly, a mouth appears with tentacles around it.



While it is forming from the egg, this jelly-fish looks like a sea plant. During its growth on the sea bed, rings appear around the body and give it the shape of a pile of plates. These "plates" break away one after the other to become new jelly-fish. Fully grown jelly-fish generally live near the surface of the sea although some kinds live in the sea depths.

UP and UP and UP...

Towering above the rolling prairies of North Dakota, U.S.A., is a television transmitting mast which took eleven men only 30 days to erect in 1963.

Were we to draw that mast to the same scale as the structures illustrated here, we would need to add about another four inches to the top of our pages—for, with a height of 2,063 feet, it is the tallest in the world.

Since the start of television—which really began properly in the early 1950s—all previous records for structural heights have been left far behind.

Before television, the tallest tower was the Eiffel Tower in Paris, designed by Alexandre Gustav Eiffel and completed in 1889 in time for the Paris Exhibition.

Originally 985 feet tall, it became important as a wireless telegraphy station and meteorological centre. But, tall as it was, it was still to grow. With the addition of a TV antenna in 1957, it topped the 1,000 feet mark and rose to a height of 1,052 feet.

It was television, too, that stretched New York's Empire State Building. When the skyscraper was completed in 1931, it was of 102 storeys and reached a height of 1,250 feet, but when a TV antenna was put on top in 1950, the world's tallest inhabited building reached a height of 1,472 feet.

Until the 20th century—when radio, television and a greater demand for building space in important cities raised heights—there were apparently only two reasons for building upwards. Man's tallest structures seem to have been built either to honour the dead or honour his maker.

From the Middle Ages to the mid-19th century, the most towering buildings were the world's cathedrals. Until ruined in a storm, Lincoln Cathedral, England, reached a height of 525 feet; until it was struck by lightning and destroyed, the second St. Paul's Cathedral, London, reached a height of 489 feet (the present cathedral, built by Wren, is 385 feet tall); and the giant of them all became Cologne Cathedral, Germany, which is 513 feet tall.

Before Christianity and cathedrals, the tombs of the Egyptian pharaohs were the tallest of the world's structures. The earliest known was the Djoser step pyramid, built in about 2,650 B.C. to a height of 204 feet. The biggest was the Great Pyramid of Cheops, built in about 2,580 B.C. to a height of 480 feet.

Transmitters and tombstones, religion and real estate—they seem unlikely partners. But they do seem to have something in common. They appear to be the main reasons why the skyline varies so much.

This is the way the builders go. Before long you might even need a clear day to see the top of the world's tallest building.



ST. PAUL'S CATHEDRAL

NELSON'S COLUMN

POST OFFICE TOWER

EIFFEL TOWER

EMPIRE STATE BUILDING



WORLD of WONDER

incorporating TELL ME WHY

EVERY MONDAY . PRICE 1/6d . No. 15 . 4th JULY 1970

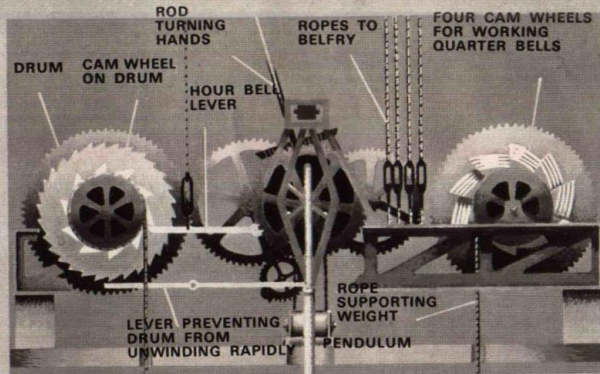
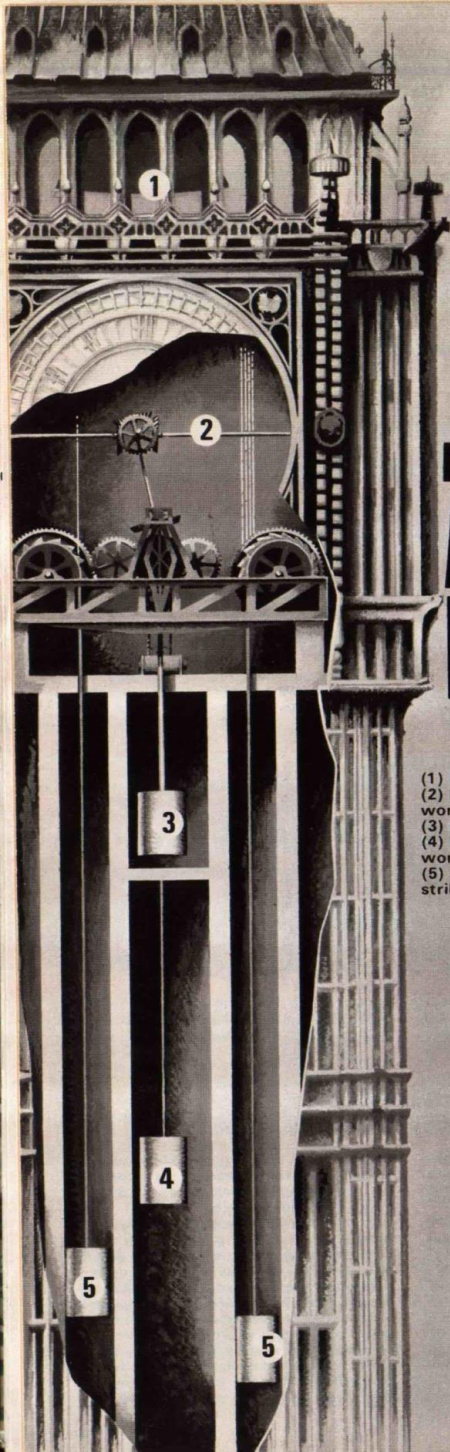
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BRING 'EM BACK ALIVE!

The exciting story
of Frank Buck.

STORY: PAGE 26.

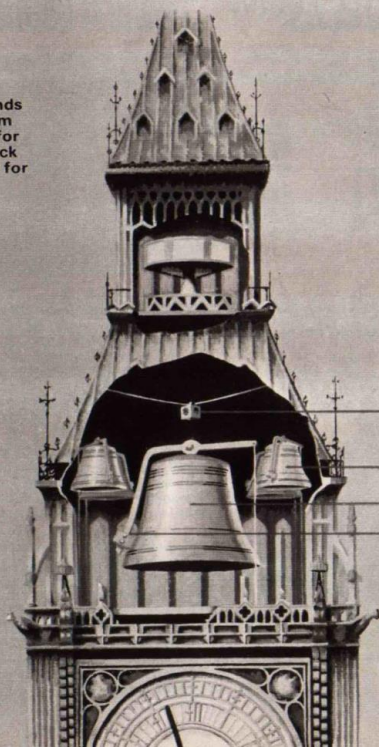




MACHINES AT WORK

A HALFPENNY KEEPS BIG BEN ON TIME

- (1) Belfry
- (2) Shafts working hands
- (3) Pendulum
- (4) Weight for working clock
- (5) Weights for striking



- Microphone for transmitting sound by radio
- Bells sounding quarter hours
- Big Ben
- Clapper

There must be few people in the world today who have not heard the majestic tone of Big Ben—the massive 13½-ton bell in the clock tower of the Houses of Parliament in London.

Installed in St. Stephen's Tower in 1858, this bell received its name in honour of Sir Benjamin Hall, who was First Commissioner of Works to the Government at the time. Since then, though, the name Big Ben has come to describe the entire clock, not just its bell.

Although people living as far apart as London, Bristol, Aberdeen and Hull can hear Big Ben striking the hours on the radio or television at the very same time, anybody standing directly beneath the clock tower would not hear the chimes until a full quarter of a second later.

This curious fact arises because of the differences in speed between sound waves and radio waves. Radio transmits sound at over 186,000 miles per second, but sound waves only travel at 1,092 feet per second—and Big Ben is housed in a clock tower 320 feet high.

There is no doubt that it is a wonderfully accurate clock. Some years ago when it was checked over 288 days at the Greenwich Observatory, Big Ben was discovered to have been wrong on only 21 occasions, but even then the error was never more than one second.

This accuracy is maintained by means of a small tray which is placed about halfway down the pendulum and when the clock is found to be losing time a halfpenny or a penny is placed on the tray to make the pendulum vibrate slightly more quickly, which gradually brings the clock back on time. If Big Ben starts gaining time, then these coins are removed.

Although the tower itself is over 300 feet high, the centres of the four faces of the clock are only 180 feet from the ground. But these dials are so huge—each is 22½ feet in diameter—that each 14-foot-long minute hand sweeps round the dial for a distance of almost 100 miles a year.

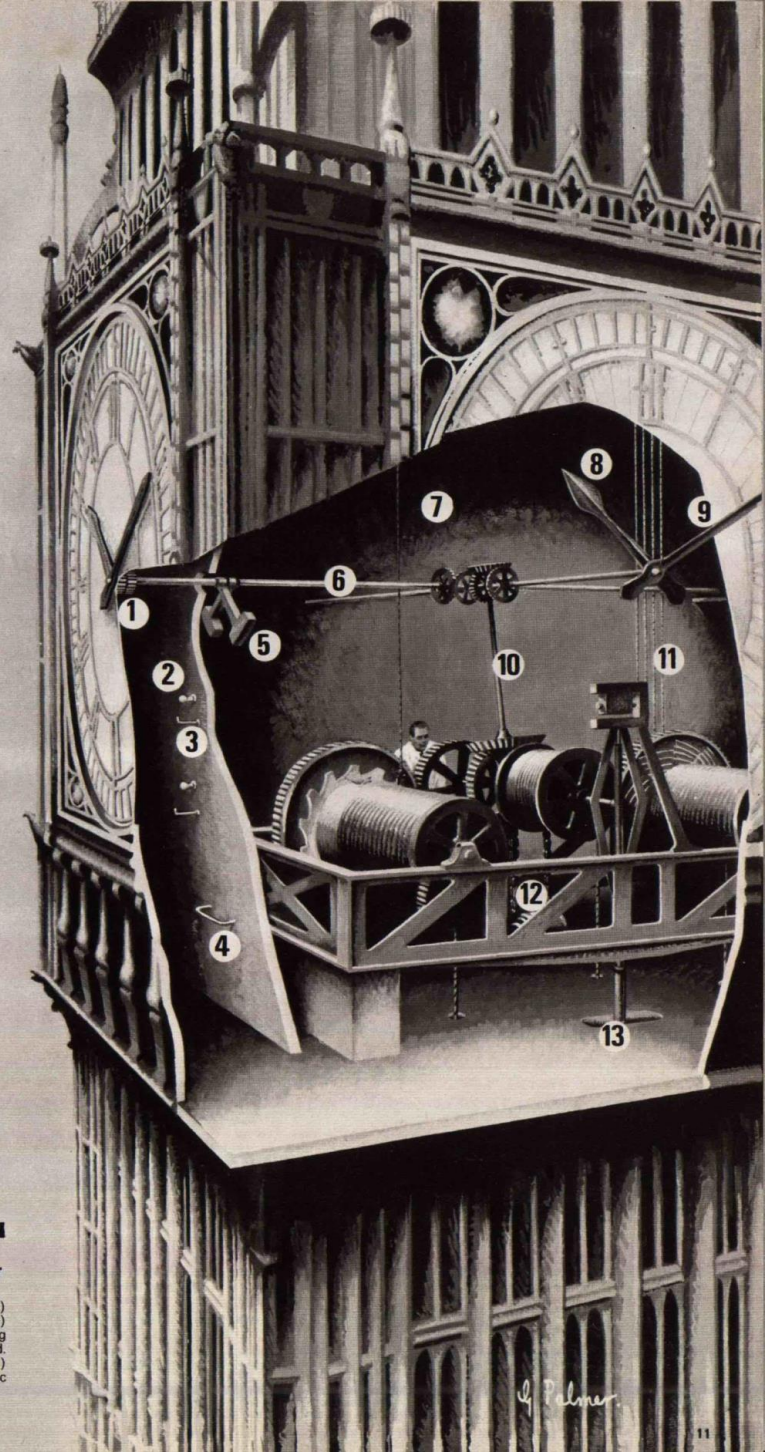
The numerals on the clock faces are two feet tall and the minute sections are one foot square. The 14-foot minute hands are each made from 224lb. of hollow copper and each hour hand is fashioned from 672lb. of gunmetal and is eleven feet in length. The 13-foot-long pendulum which controls the clock has an end piece—or "bob"—which weighs 448lb.

The hammer that strikes Big Ben weighs a hefty four hundredweights and the four quarter bells in the clock tower weigh almost eight tons: one is three tons 18cwt, the second is one ton 13cwt, the third is one ton six cwt and the fourth is one ton one cwt.

There have been two Big Bens. The first bell, which was cast at a Whitechapel foundry weighed 16 tons 11lb. but was found to be cracked in 1857. So it was melted down and recast to make the one that has been pealing out the hours since 1858.

KEY TO ILLUSTRATION ON RIGHT

- (1) Geared wheels working hour hands. (2) Electric bulbs. (3) Disused gas jets. (4) Steps. (5) Counterbalance weights. (6) Shafts for working hands. (7) Rope ringing hour bell. (8) Hour hand. (9) Minute hand. (10) Rod turning dial shafts. (11) Ropes for ringing quarter hours. (12) Electric motor for winding clock. (13) Pendulum.



W. Palmer

ALL HEADS AND TAILS

Way back in Roman times, when Pliny the Elder was Consul in Spain, he claimed that a huge monster used to come ashore at night and plunder the salt-fish warehouses.

A noted romancer, Pliny was exaggerating—monstrously. But he was obviously referring to the giant cuttlefish or squid, a member of the strange and hideous underwater family known as the *cephalopods*, a name which means "head-footed" creatures.

Found in practically every sea in the world, even in the Antarctic, cuttlefish vary in size from a few inches to as much as maybe 60 feet.

Recognisable by its elongated body and ten tentacles—two longer than the rest—the cuttlefish usually lies in wait for its prey, which it seizes with snaking tail-like tentacles. On each of these are sucking discs fitted with sharp claws which tear the prey to pieces.

Its head contains an opening which ejects

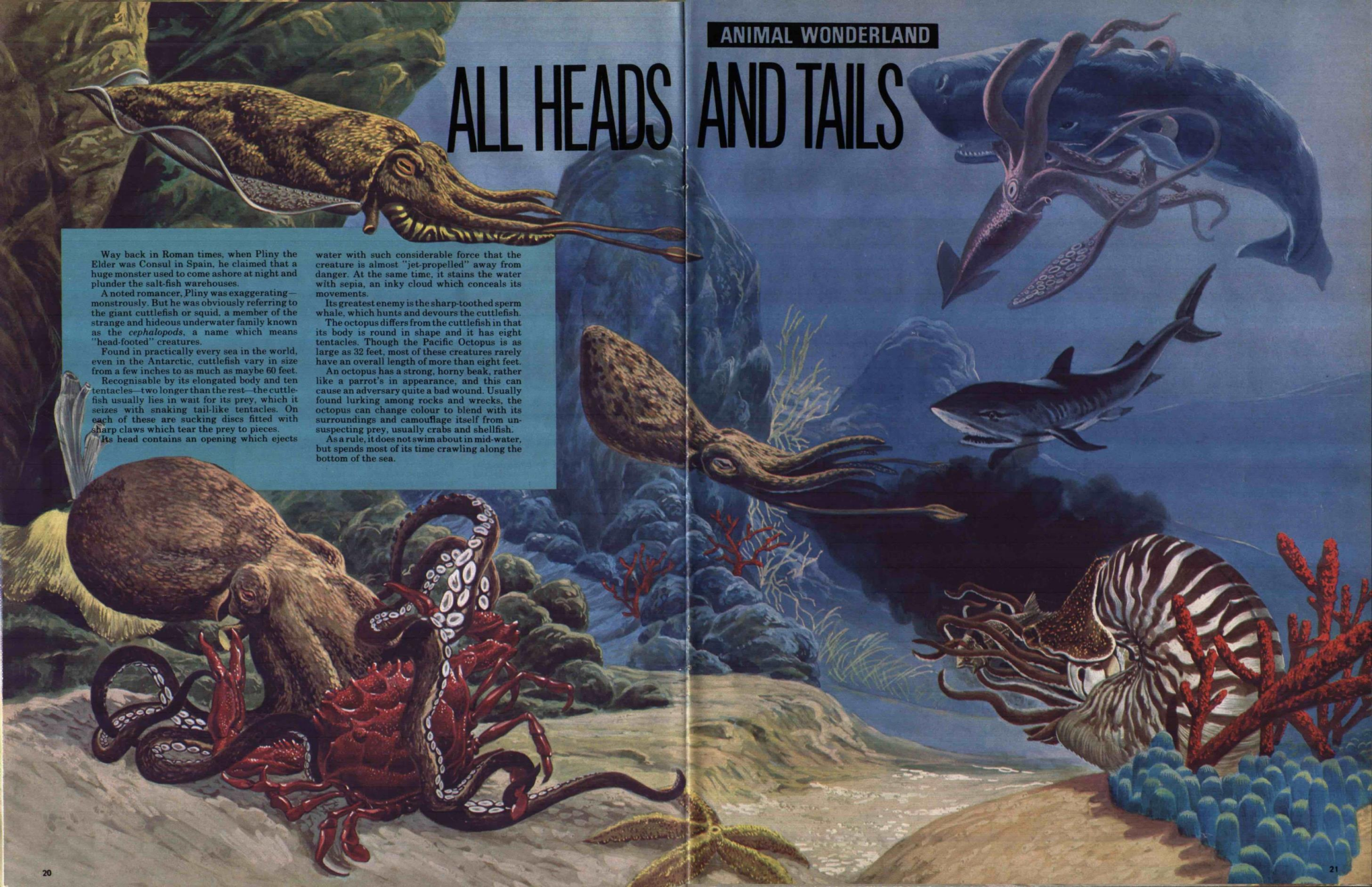
water with such considerable force that the creature is almost "jet-propelled" away from danger. At the same time, it stains the water with sepia, an inky cloud which conceals its movements.

Its greatest enemy is the sharp-toothed sperm whale, which hunts and devours the cuttlefish.

The octopus differs from the cuttlefish in that its body is round in shape and it has eight tentacles. Though the Pacific Octopus is as large as 32 feet, most of these creatures rarely have an overall length of more than eight feet.

An octopus has a strong, horny beak, rather like a parrot's in appearance, and this can cause an adversary quite a bad wound. Usually found lurking among rocks and wrecks, the octopus can change colour to blend with its surroundings and camouflage itself from unsuspecting prey, usually crabs and shellfish.

As a rule, it does not swim about in mid-water, but spends most of its time crawling along the bottom of the sea.



WORLD of WONDER

incorporating **TELL ME WHY**

EVERY MONDAY . PRICE 1/6d . No. 16 . 11th JULY 1970

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MARCH OF THE LUDDITES

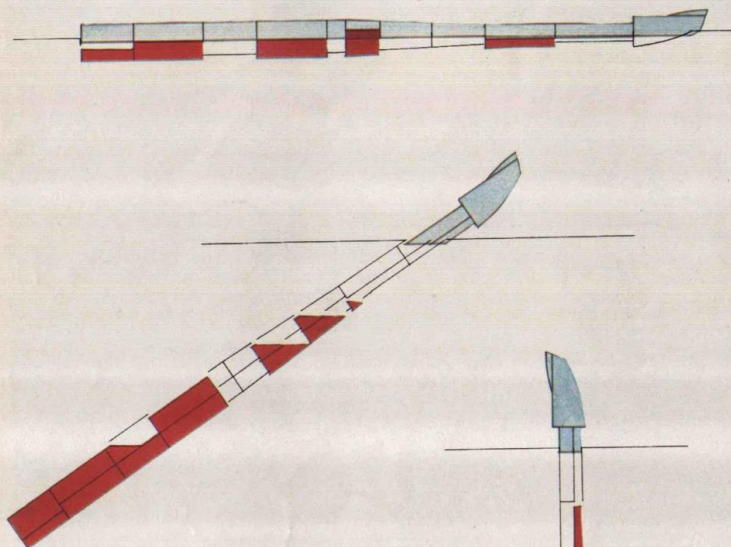
STORY: PAGE 22



FLIP

THE SHIP THAT STANDS ON ITS NOSE

FLIPPING SEQUENCE (shown left)
The hull, or 300 feet of tube which is below the water, is gradually filled with water, as shown by the red on the small illustrations. Strict order of tank filling is carried out to ensure that FLIP does not roll and throw equipment about.



With three-fifths of the Earth's surface under water it is only a matter of time before the land areas become overpopulated to such an extent that we will have to look elsewhere to grow our food.

So men are already probing under the sea, for it is well known that the vegetables and plants that grow there contain high amounts of vitamins and goodness of every sort.

However, long before man can reap the fantastic harvest of food from under the sea, he must know the currents, the contents of the water, how temperature affects growth, mineral contents, fish migration, breeding, even fish languages.

For six years or so an unusual ship has been carrying out research into all these problems and is beginning to provide some answers to some very interesting questions.

The ship is called FLIP (Floating Instrument Platform) and operates in the way shown in the small sketches.

Let us say the scientists wish to study how a particular current moves in the Pacific Ocean. The FLIP is towed to the agreed spot and then it literally takes a nose dive into the sea.

The ballast tanks are filled with water in a certain sequence and slowly the nose sinks under water, the stern rises and eventually the whole vessel is standing absolutely upright.

The ship, which is 350 feet long when in the normal horizontal position, now has 300 feet below the surface and 50 feet above it. This rear (or top) 50 feet contains the laboratories, quarters, engine rooms and so on.

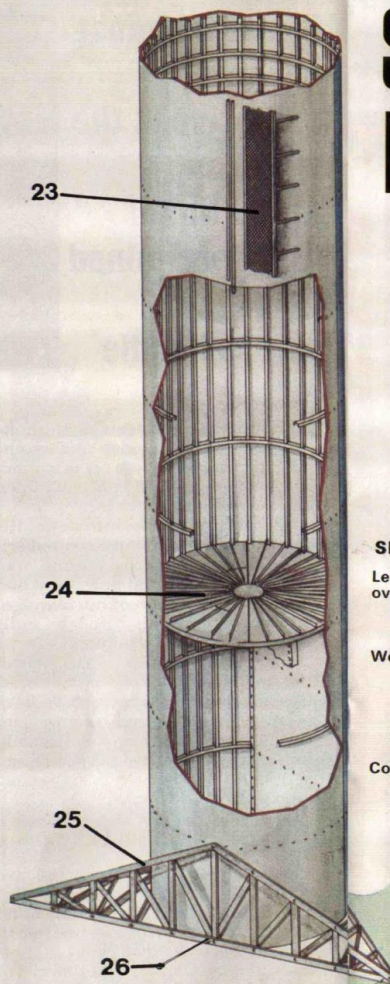
Inside this manned part are some of the strangest features ever found aboard a ship. All the furniture, fittings and equipment can be used when the vessel is horizontal or vertical simply by turning them on their pivots.

A wall in the horizontal position becomes a floor or ceiling in the vertical position; the floor becomes a wall, a trap door becomes the entrance to a room.

It is a weird sensation, walking on what was once a wall, but the scientists and crew soon adapt themselves to the new position. They spend several months aboard the FLIP before being towed back to port.

There is little chance of them being sea-sick. Even in very heavy seas the FLIP ship stays almost motionless when it is vertical, and the scientists are able to work undisturbed by the elements.

FLIP is just a big buoy, free-floating and being carried across the oceans at the whim of wind and sea. But it is a big buoy which is playing a vital part in Man's quest under the sea.

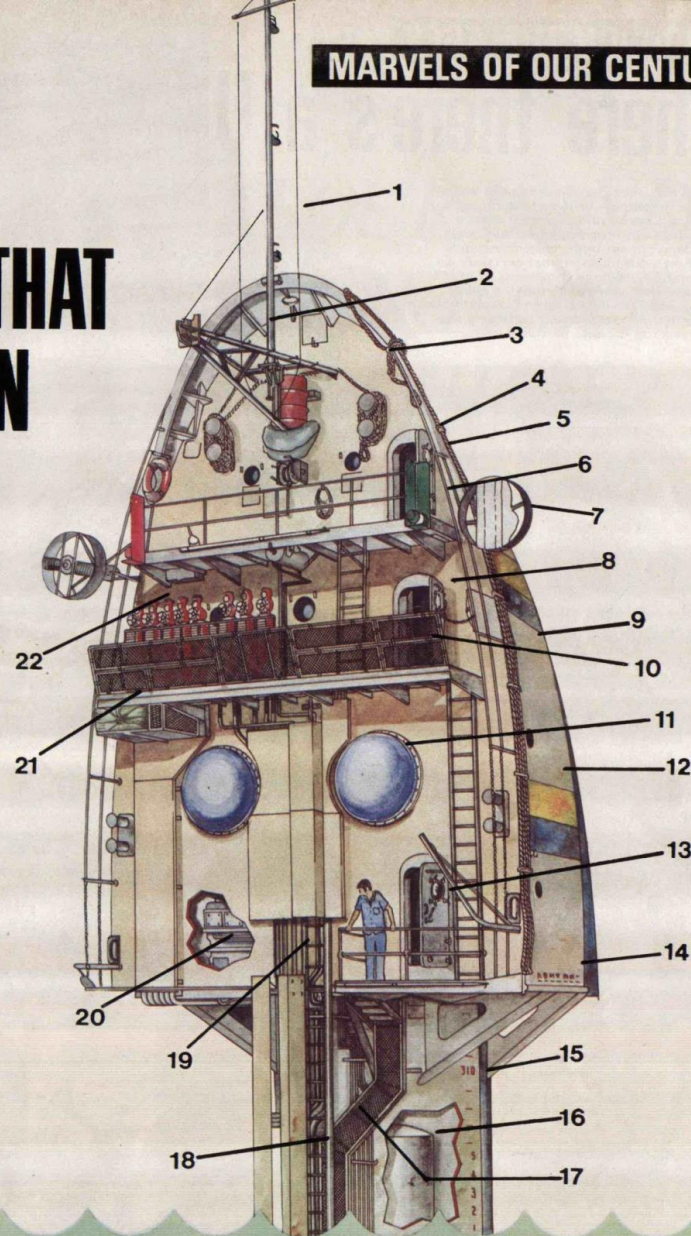


SPECIFICATIONS

Length overall: 350 feet. When in operating position 50 feet is above water and 300 below.

Weight: 600 tons dry. 1,500 tons in towing (horizontal) position. 2,100 tons fully flooded (vertical).

Complement: 6-7 Scientists
6 Operators (crew)



1 Mast carrying navigation lights when in vertical position. 2 Winch for collecting deep water (3,000 feet and deeper) samples. 3 Working deck or forecastle when in horizontal position. 4 Entrance to scientific part of FLIP. Laboratories for processing data collected are very up-to-date. 5 Top gallery. 6 Starboard navigation light. 7 One of the two propellers which can turn FLIP about its axis. Here, one is partly covered to act as a sail. This slight bias on one side will keep FLIP in an exact position without running motors to drive fans, so long as wind does not vary. 8 Entrance to electronics laboratory and radio room. 9 Heavy emergency towing lines. 10 Mid gallery. 11 Freshwater tanks and series such as gas oil for engines which

provide electricity and power for all the running of FLIP. 12 In this section of FLIP is housed the living quarters. Cabins, galley and mess rooms. 13 Entrance to donkey-engine room and workshops. 14 Measurements of draught for use when FLIP is horizontal. 15 Draught measurements for use when vertical. 16 Compressed air tanks. 17 Walk-way for use when FLIP is horizontal. 18 Ladder for boarding FLIP when vertical. 19 Compressed air pipes for "blowing" tanks and electrical leads to instruments. 20 Diesel engine for generators. 21 Liferail. 22 Tank valves. 23 Walkway leading to tip of FLIP. 24 Bulkhead. 25 Hull outriggers. 26 Hydroplanes.

WORLD of WONDER

EVERY MONDAY . PRICE 1/6d . No. 18 . 25th JULY 1970

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**TREASURE ON
TRINIDAD**
STORY: PAGE 21



TERRORS of the DEEP

Forget about sharks. Unless you know how to tell one from another, do the safe thing and stay away from them. Even though 230 of the more than 250 species known are believed to be harmless to Man, the others are so treacherous and dangerous, and cunning with it, that they are probably Man's greatest animal enemy.

You will have read stories that shouting or splashing at sharks causes them to turn tail and flee, but only because such stories are unusual.

The nearer truth is that man-eaters are fearless and ruthless in their pursuit of prey. Grey Nurse sharks are known to sidle into shallows and creep on their bellies across sand to snatch unsuspecting paddlers; huge Tiger sharks are known to attack and overturn fishing boats to get their crews; and the fiercest of all, the White Death, which may be as large as

60 feet, will attack almost anything that comes its way, including rowing boats which present no problems to digestive juices capable of dissolving metal!

Attempting to fight back is usually a pointless exercise, for most killer sharks never know when they are dead. Some can fight for a day at the end of a fisherman's line, be sliced with knife wounds, heavily clubbed and shot, yet still stay alive and savage a man.

The most vicious of all are to be found around the Australian coasts, some hunting mercilessly in packs, others, like the Hammerhead and White Death, hunting alone. Generally the female is more courageous and formidable than the male.

So forget about sharks—even though 23 out of every 25 are theoretically harmless. If you can't tell one from another, don't wait to ask questions. It could be an unhealthy curiosity.

A fold of skin at the corners of its great mouth gives the TIGER SHARK a slightly diabolical "grin" which somehow adds extra horror to its fearful reputation. Up to 30 feet long, it inhabits most of the tropical seas of the world and has caused considerable loss of life. The smaller sharks—up to 14 feet—are the most dangerous, for they can glide into shallow waters to attack bathers.

The DOGFISH—a species of smaller spotted sharks—were given their name because of their habit of hunting prey in packs. Sometimes called "hounds" or "beagles", they are found mostly in temperate and tropical seas and feed mainly on smaller fish or shellfish. They lay their eggs in semi-transparent cases which hang on seaweed until hatching time.

No one is sure why the HAMMER-HEAD SHARK should have such a peculiar head shape, but its widely spaced eyes give it a wide range of vision which helps it to spot prey easily. Up to 20 feet in length, these sharks are energetic, highly-strung and nervous by nature, which makes them particularly dangerous. They are difficult to capture because they fight to the death.

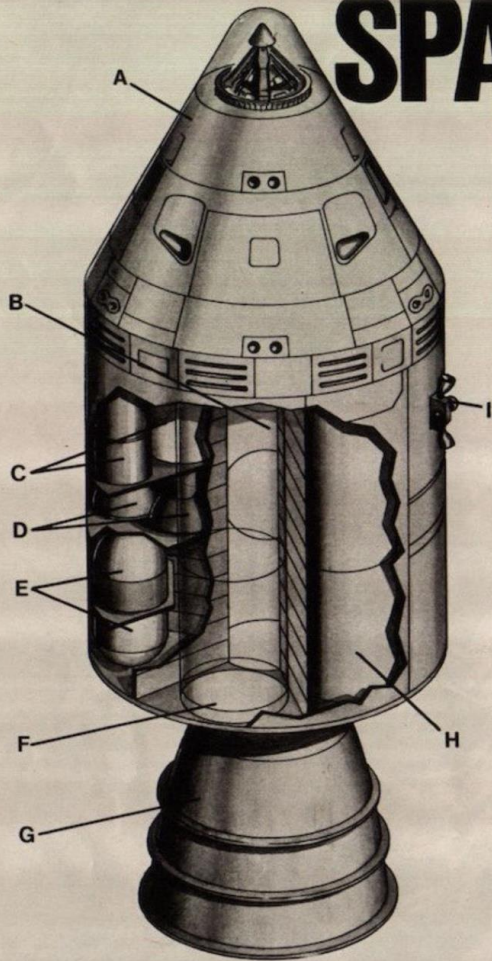
When you think of the ANGEL FISH, you usually think of the attractive fish kept in an aquarium. However, the name also applies to some members of the shark family. This one, also known as the MONK FISH, is often found round the British coasts. It is a link between the shark and the skate, which it resembles. Often growing to a length of five feet, it lives at the bottom of shallower seas, feeding mainly on shellfish.

It seems likely that the NURSE SHARK is so named because it keeps its eggs in its body until they hatch and then expels the egg cases along with the young. About eight feet long at the most, it is a hardy shark which spends most of its time on the sea bottom or among reefs, feeding on shellfish. Until fairly recently it was considered harmless to Man, but it is now known to be quite dangerous if disturbed suddenly.

The true DOGFISH, often to be found round the British coast, is a species of shark—sharks being cartilaginous fishes; that is, their skeletons are made of gristle instead of bone. This species, you can safely say, is not dangerous because it is too small to attack humans. Living on whelks, cuttles, crabs and fish, its natural habitat is the rocky shallows. Quite good to eat, it is better known on the fishmonger's slab as rock salmon.

SPACE SCARE

MARVELS OF OUR CENTURY



When the voice of Commander James Lovell came over the miles of space with the words "Hey, Houston, we've had a problem", he must have been speaking the understatement of the century.

The mission of Apollo 13 had been to land two men on the Moon, and make further studies of Man's ability to work in the lunar environment. But at just after 4.40 a.m. (B.S.T.) on 14th April, 1970, following a 33-minute broadcast from *Odyssey*, the command ship, Lovell's words crackled through space.

Commander James Lovell reported a loud bang and sudden loss of power. Oxygen hissed from the vital power cells compartment in the service module, and with the life-supporting oxygen and electrical power draining away the position looked bad.

To conserve power, no hot food was prepared. The life support systems were switched off and lights were extinguished in the command module.

If the explosion had taken place after a lunar landing, there would have been no means of getting back to Earth. As it was, the astronauts were approaching the Moon when the explosion 'killed' their service module.

So the lunar excursion module (LEM) called *Aquarius* was to change role and become a space lifeboat. As its engine was not powerful enough to provide a 'U' turn in space, the mission had to go into an orbit round the Moon which would give the turn round—provided the engine in *Aquarius* worked.

It did, and the first real hurdle was cleared. Problems cropped up hour by hour, but with the assistance of computers and brains back at mission control in Houston, Texas, many do it yourself jobs were done.

Oxygen left in the craft was enough to support life for seven days, so if all else went well that would last. But water looked like becoming a problem, not only because there was not enough in the craft for all purposes, but because it was needed for cooling purposes.

As the world waited, the three astronauts planned their re-entry into the Earth's atmosphere. One big worry was about their ceramic heatshield which allowed the craft and its occupants to enter the atmosphere without burning up.

There was a fear that this might have been damaged in the explosion. If this was the case—and a mere crack would have been enough—the craft and its occupants would have cooked within a few seconds of re-entry.

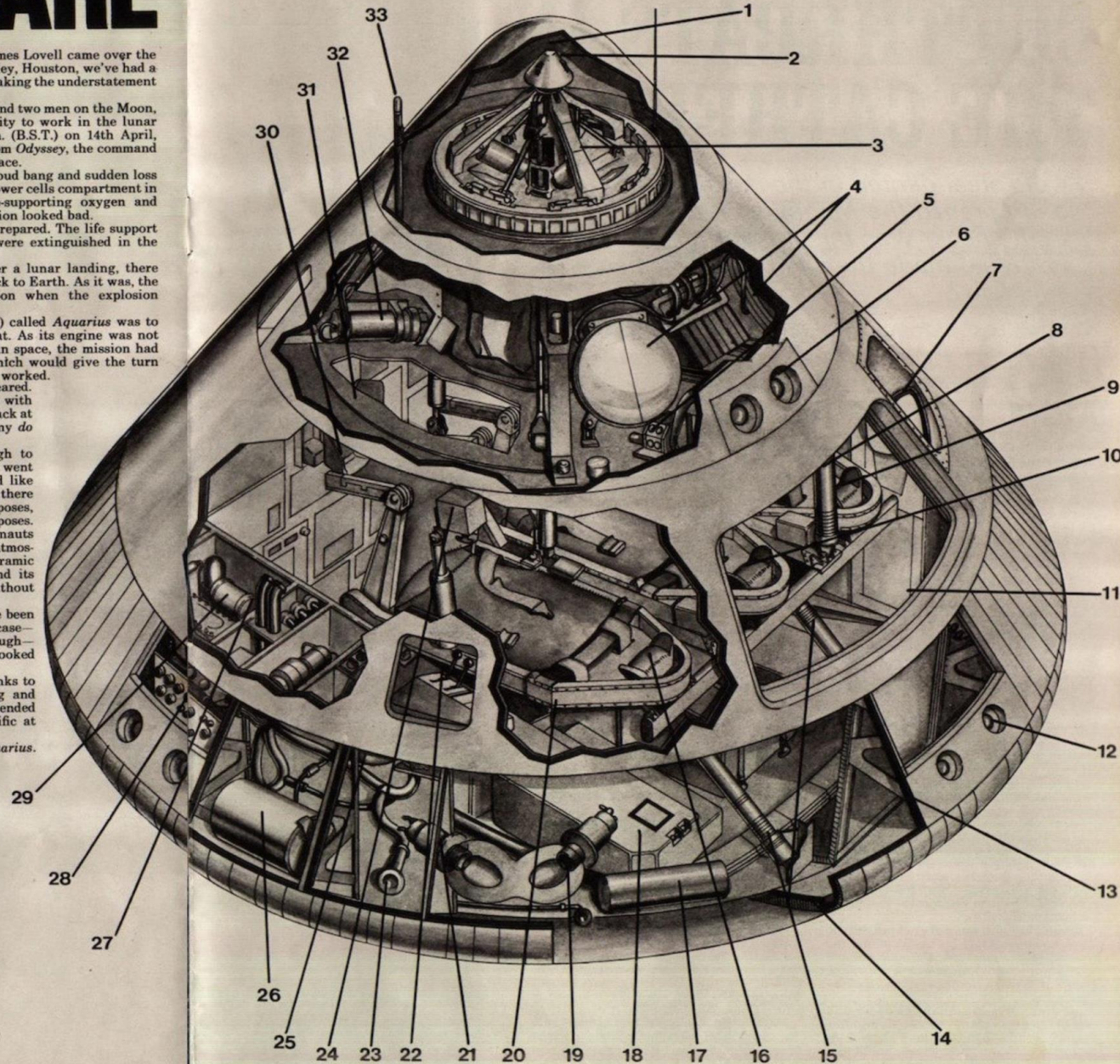
All went well, as you know, and thanks to painstaking engineering and unending and sound technical advice, the mission ended with a perfect splashdown in the Pacific at 7.07 p.m. (B.S.T.) on 17th April, 1970.

Next week we will look at L.E.M. *Aquarius*.

A LOOK INSIDE THE UNLUCKY APOLLO 13

ABOVE—COMBINED SPACECRAFT AND SERVICE MODULE. A. Command module. B. Helium tanks in centre. C. Fuel cell power plants. (At the time of going to press, it is believed that this is where the trouble in the form of an explosion took place. Exterior panels were blown out and these cells which provided electricity for many purposes failed completely.) D. Cryogenic (O₂) fuel tanks. E. Cryogenic (H₂) fuel tanks. F. Fuel sump tank. G. Engine expansion nozzle. H. Nitrogen-tetroxide oxidiser tank. I. Roll and pitch control rocket motor guard.

RIGHT: THE COMMAND MODULE. 1 Docking probe. 2 Locking latches. 3 Shock arms. 4 Drogue parachute mortar. At 23,000 feet, a 16.5-foot conical ribbon parachute slows the ride through the air from 300 to 175 m.p.h. 5 Equipment which releases a pale yellow-green dye marker into the water to aid location of capsule. 6 Negative pitch altitude control motors (33lb. thrust). 7 Window. Double glazed. Inner: 25 tempered silica. Outer: Amorphous-fused silica (0.70 inches thick). Infra-red and ultra-violet filters. 8 Shock absorber. 9 Headrest of 3rd crew member's couch. 10 Centre crew member's headrest. 11 Hatch opening (29 inches x 34 inches). 12 Positive pitch control and altitude motor. 13 Sandwich of stainless steel honeycombs. 14 Ceramic heat shield which can withstand 5,000 degrees of heat during re-entry. 15 Shock absorbers. 16 Commander's couch. 17 Storage for nylon bag, shaped to allow a crew member to climb in and zip himself in for sleep. While taped and zipped in, he can sleep without floating about in the weightless conditions of space. 18 Stowage for pressure suits. 19 Positive roll motor. 20 Sleeping space under couches. 21 Negative roll motor. 22 Cabin pressure controls. 23 Steam vent pipe. 24 Thrust controller. 25 Spherical oxygen surge tank. 26 Water tank. 27 Oxygen pipes. 28 External service hatch. 29 Compressors for space suits. 30 Foot-rest on couch. 31 Space for main parachutes. 32 Pilot parachute mortar. Fires at 10,000 feet, dragging out main chutes. 33 Recovery beacon. Flashing light on top.



WORLD of WONDER

EVERY MONDAY . PRICE 1/6d . No. 19 . 1st AUGUST 1970

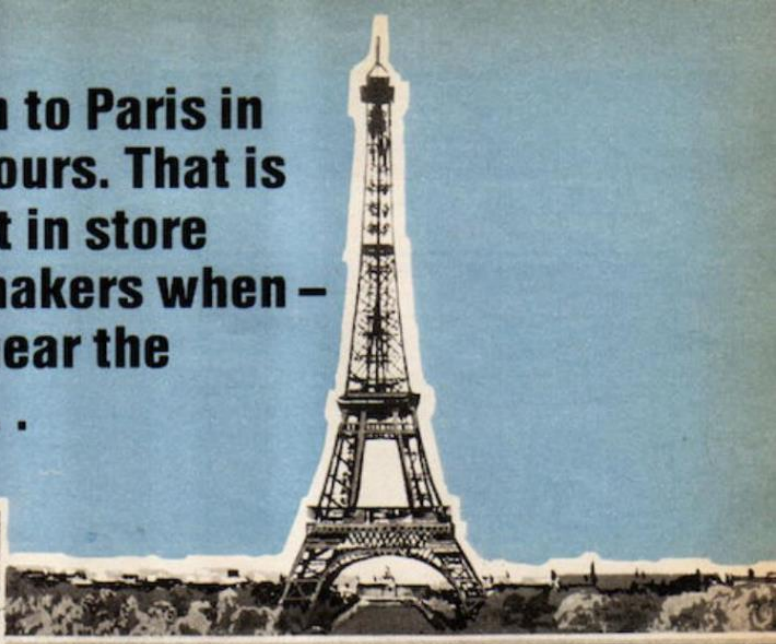
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**ALL CHANGE
FOR THE
CHUNNEL!** STORY: PAGE 15

TALKING POINT

From London to Paris in just a few hours. That is the prospect in store for holidaymakers when – or if – they hear the guard call . . .

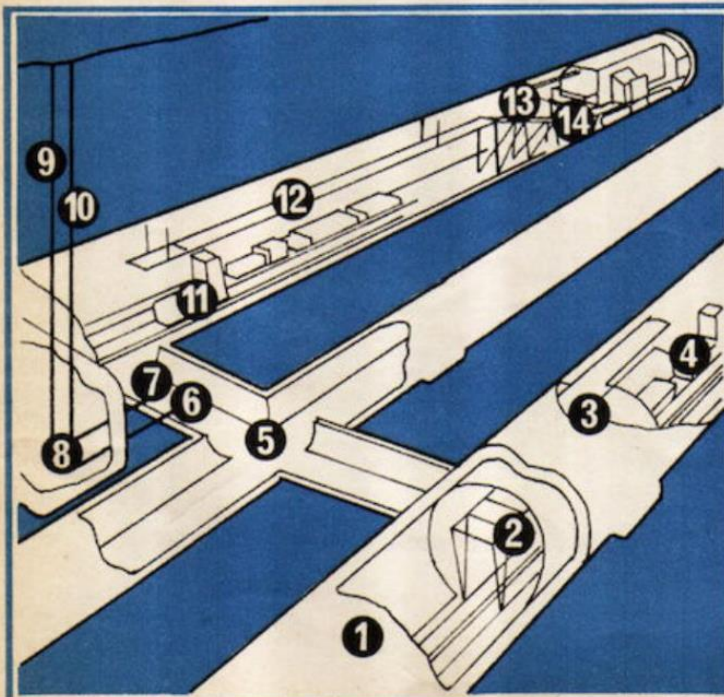


ALL CHANGE FOR THE CHUNNEL!

Holidaymakers going to Europe will be able to get on a train at London's Victoria station, sit back, and arrive on the coast of France a short while later.

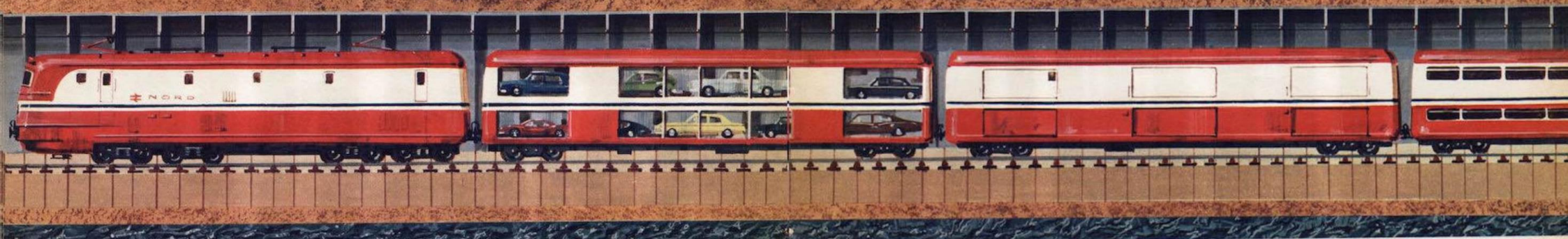
That's the vision of the not-too-distant future—if and when a tunnel under the English Channel is built.

Passengers will have only a short ride to the coast, where the one and only change takes place. They will leave the narrower gauge trains used in Britain and climb into the broader continental ones. Once aboard, the train will pull out of the big passenger terminal at Cheriton, a mile north of Folkestone, follow the looping



WORM'S EYE VIEW

- 1 Main Tunnel.
- 2 Portable Trestle running on rails.
- 3 Liquid concrete being pumped to seal against steel lining.
- 4 Concrete mixer and pump.
- 5 Service Tunnel.
- 6 Turbine to draw in sea water.
- 7 Pump to extract crushed rock and sea water mixture known as slurry.
- 8 Pump house.
- 9 Slurry disposal pipe.
- 10 Sea water inlet.
- 11 Stone crusher and sea water mixer.
- 12 Telescopic conveyor belt.
- 13 Steel rib carrier.
- 14 Boring machine.



The picture above shows the type of train which is likely to be used in the Chunnel. The track will be the continental gauge, which is wider than the English one. Rolling stock will carry motor vehicles and goods in containers as well as passengers.

The lower picture shows the two main tunnels and the service tunnel in the centre emerging at ground level.



FOR THE FIRST TIME IN HISTORY THE

line round till the engine faces the sea again, and clank down a slight incline till it finally enters the Channel Tunnel.

Thirty-five minutes later it will have climbed back to the surface and be pulling into the customs post near Calais.

Formalities over, the passengers will be free to catch another train going anywhere on the Continent, or stay on the original one and arrive in Paris a few hours after leaving London.

The time it will take from London to Paris will be roughly the same as it is to fly.

Holidaymakers, as well as industrialists and everybody else who will want to use the Tunnel, will have to wait

for at least another seven years however. While routes have long been selected, sites decided on and plans made there is no firm date for the start of the "big dig". The earliest date work can begin is sometime in 1972 and it will take five years to construct.

Napoleonic Idea

The plan for the Channel Tunnel has had more than its fair share of ups and downs—and they have mostly been downs!

Ever since the idea first occurred to one of Napoleon's generals as the easiest way to invade England in 1803, the British have been shy of it. But no

BRITISH WILL NO LONGER BE LIVING ON AN ISLAND

matter how much cold water has been poured on the plan in the years since, there has always been someone to propose it yet again.

One group nearly made it in 1880, when drilling began on Shakespeare Cliff near Dover and at Sangatte near Calais, but tunnelling was stopped two years later for fear it could be an invasion route.

Invasion, in fact, never could be a possibility. Even in 1880 the French army reckoned it would take five days to send 150,000 men across—if they had the co-operation of the British authorities. Had the tunnel been built, in fact, Dunkirk (see *WORLD of WONDER* No. 12) might never have happened.

Despite discouragement, the profits to be made from an easier flow of goods and people between the two countries have always acted as a spur. This latest attempt to build the "Chunnel", as it is often called, began in 1957 and, for a change, has been gathering impetus ever since.

Jinx At Work

This pioneer was the Channel Tunnel Group, engineers and bankers who are the direct offspring of the firm which began the original work in 1880.

Having spent over a million pounds on exploratory work, this group set out to convince both governments that a

start should be made. But the jinx which has bedevilled the whole operation from the beginning was still at work. Not until 1966 did the governments agree that it should be built.

Plans calling for two tunnels to be drilled in the chalk under the channel were finally published in 1968. They accomplished one thing at least. The rival cross-channel concept of a huge bridge was firmly knocked on the head. Argument over the Chunnel, however, still goes on.

If built, each tunnel will be one way only. There will be no roadway, instead cars and lorries will drive onto specially built carriages that will carry them the 35 miles to the other side. Once there

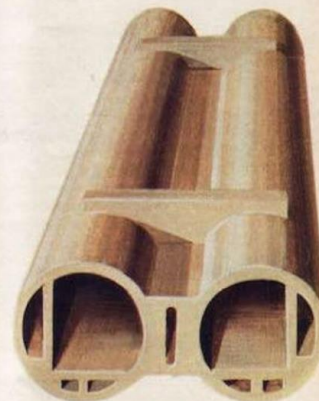
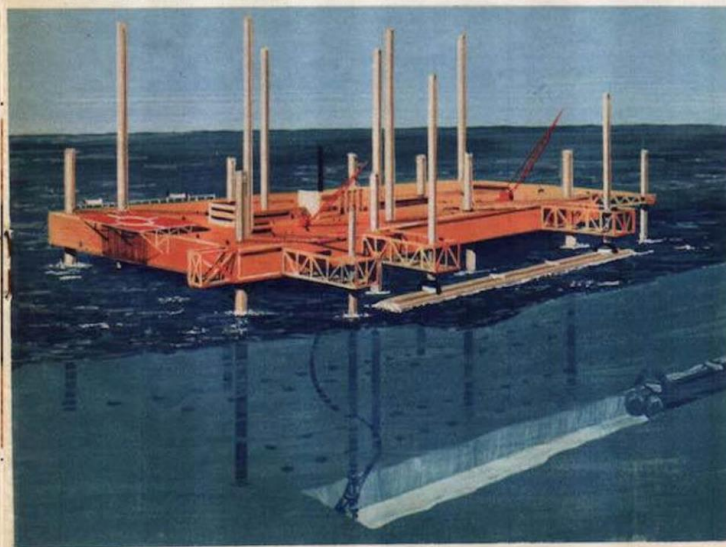
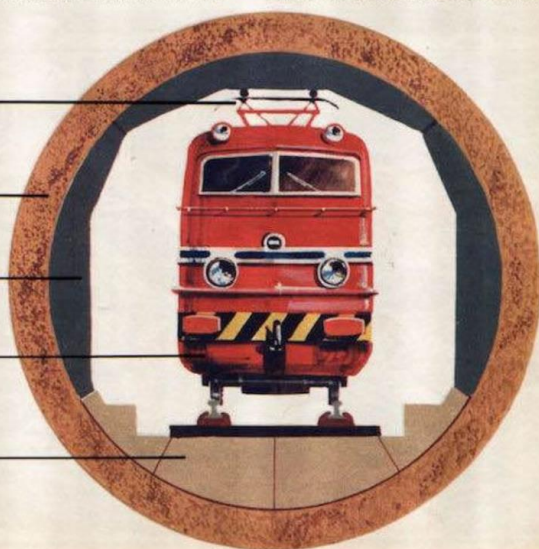
Live wire and insulators

Concrete outer casing

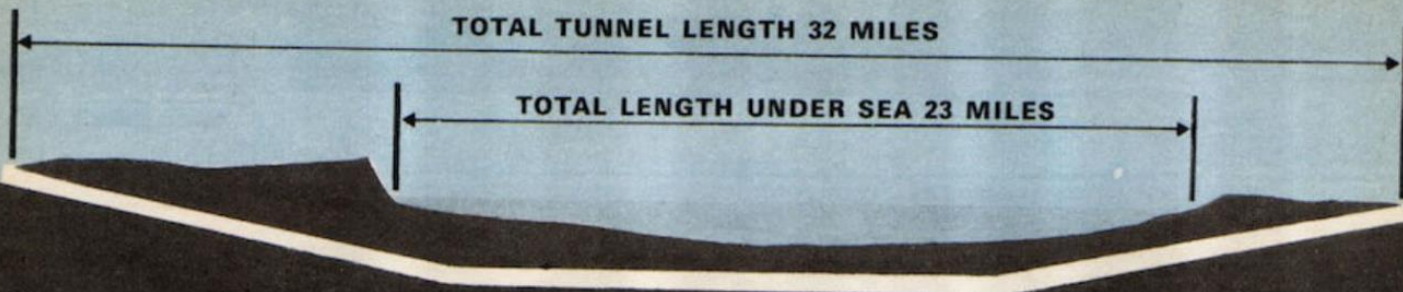
Steel lining erected in sections.

Locomotive similar to powerful French rolling stock.

Track placed on to interlocking pre-cast blocks laid in tunnel



An alternative method of constructing the tunnel is to have pre-cast sections (as above) sealed and lowered into a trench. The whole operation would be carried out from large platforms which would "walk" on giant stilts, laying the tunnel as it went.



This diagram (not to scale) shows how the tunnel will go down a slight slope to the main underwater section and climbs up at the other end. The total distance from the English to the French terminals will be 44 miles. On the English side the terminal will be 17 miles from the coast, while on the French side it will be only four miles from the coast. At the deepest section of the tunnel it will be 160 feet below the sea bed, which will be in the region of 500 feet below sea level.

they will drive off, pass through the customs and be on their way.

Entering the portal at Sangatte, the foreign traveller will be brought to England and dropped off at the passenger terminal where he will change to a British train. The Chunnel express, which will run on overhead electrification, will then take on more passengers before going back to France.

Huge Affair

The Chunnel station will be a huge affair, so big it is planned as three separate units which may be some miles from each other. Smallest will be the passenger terminal. This will cover approximately 15 acres and have 12 platforms.

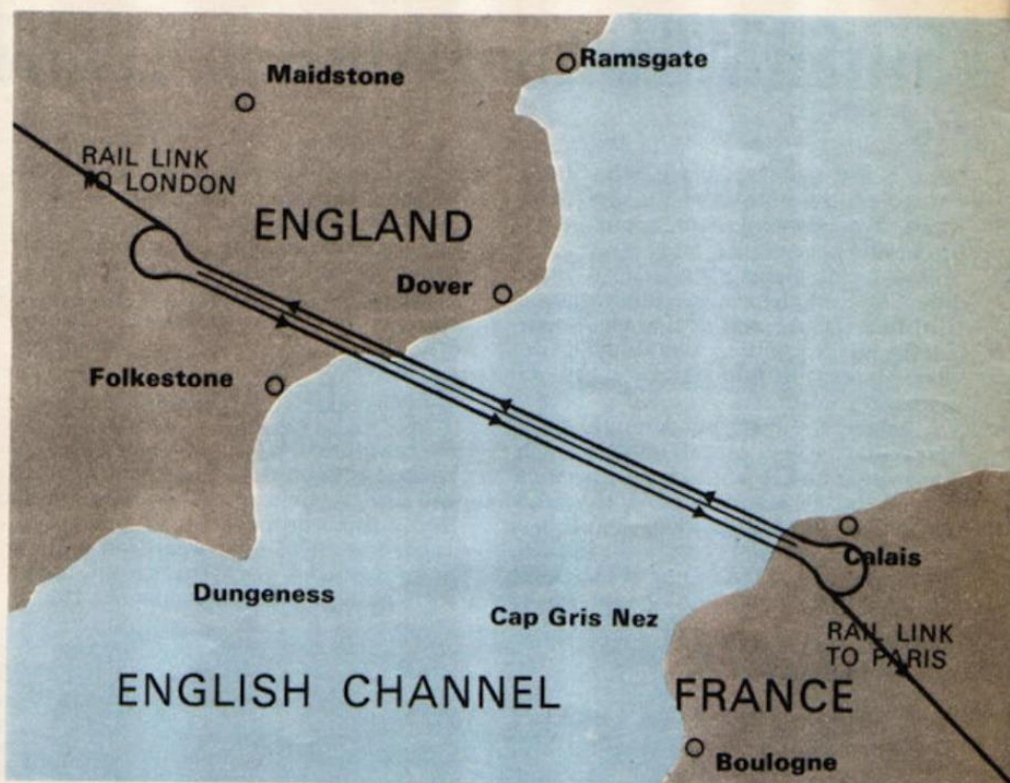
Behind them will be customs, exchanges, toll booths and other offices normal at international crossing points. The ferry terminal, which will take cars, caravans and lorries will be the largest, covering anything up to 250 acres. Finally the freight yard, which will handle goods to be sent direct, like container wagons for example, will be approximately 60 acres.

Travellers using the Chunnel need not expect to wait long for a train. It is estimated there will be 15 trains an hour at peak periods. The ferry terminal will be no less busy. Chunnel trains will be able to cope with up to 3,000 vehicles an hour in each direction.

Ever-Rising Costs

Travel will be so quick and easy that people living in the South East of England will eventually think nothing of spending an evening in France. For the first time in history the British will no longer be living on an island.

The biggest single stumbling block till now has been money. The cost frightens everybody. The original 1960 estimate was £117,000,000, but it has



The map above shows the proposed location of the tunnel and its terminal loops at either end. It is not the shortest distance across the Channel but the most convenient for linking with the main rail services to London and Paris.

gone way up since then. Every year the plans gather dust increases the eventual price by £10,000,000 at least. The 1969 estimate was £250,000,000 as a minimum—but others put it as high as £600,000,000.

If it did cost as much as that, say the opponents, tolls would never get the money back. It would be cheaper to fly or take a ferry.

To make matters a little more difficult there were, at the last count, 25 banks and four engineering firms in four different countries trying to influence

the building of the Chunnel.

While pro-Chunnelites have been working hard to get everybody to pull together in the same direction at the same time, the jinx was working just as hard. A survey published last year showed few people in Britain really wanted it built!

As it stands now, the government looks as if it may be changing its mind yet again. It intends to make its own, national survey, sometime later this year to let the public decide the matter once and for all.

One out of every six ships on the high seas is an oil tanker

SEA GIANTS

Geared steam turbine engines are usual in oil tankers. Speeds range from $11\frac{1}{2}$ to $16\frac{1}{2}$ knots. A giant among them is the s.s. *British Admiral*, which you can see on these pages. It has a deadweight of 100,000 tons. Deadweight tonnage is the weight of the cargo, stores, water bunkers and fuel needed to drive the ship.

Gross tonnage is arrived at by measuring the enclosed space below deck in cubic feet and dividing by 100.

Japan has an even bigger tanker, the *Tokyo Maru* with a deadweight of 150,000 tons. Key to the picture: A. Anchor winches. B. Fore and aft gangway. C. and D. Cargo manifold (for loading and discharging). E. Cargo tanks. F. Cargo pipelines. G. Oil fuel bunker tank. H. 2nd engineer's day room. J. Captain's bedroom. K. Navigating bridge. L. Radio room. M. Swimming pool. N. Officers' cabins. O. Chief engineer's day room. P. Hospital. Q. Galley. R. Crew's recreation room. S. Boiler room. T. Store room. U. Steering gear. V. Engine room. W. Propeller shaft.

tons, had been spilling its cargo of crude oil into the Atlantic. Attempts to tow the ship clear had failed.

So, once the crew were safely away, the tanker was bombed by the R.A.F. and Royal Navy to burst open its tanks. Petrol and fire bombs were dropped to set the oil alight before it could clog up beaches or kill wildlife. At one time, a stretch of sea over a mile wide was blazing.

Finally, the job was finished. The shattered *Torrey Canyon* was safe enough to be handed over to the salvage teams—an empty shell of creaking, groaning metal.

This is the sort of story about oil tankers

that usually makes the big headlines. Because it has such drama and excitement, it claims the front pages of all the national newspapers for a few days.

Valuable Cargo

Perhaps reading such a story was your first introduction to oil tankers, but happily it is not the most common. And though the more solid, day-to-day story does not make the headlines, it is nonetheless worth telling, for without tankers our lives would be uncomfortable to say the least.

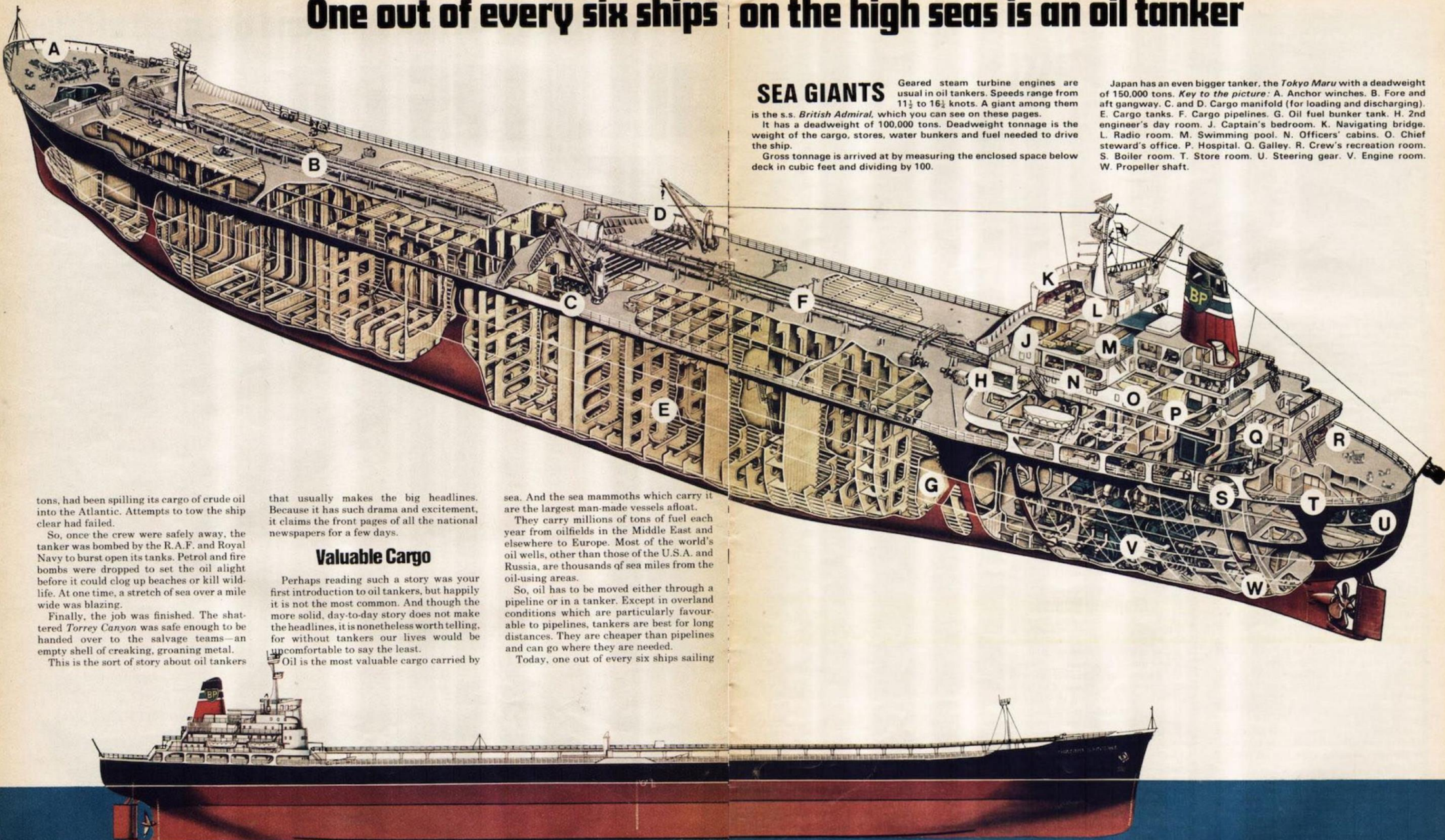
Oil is the most valuable cargo carried by

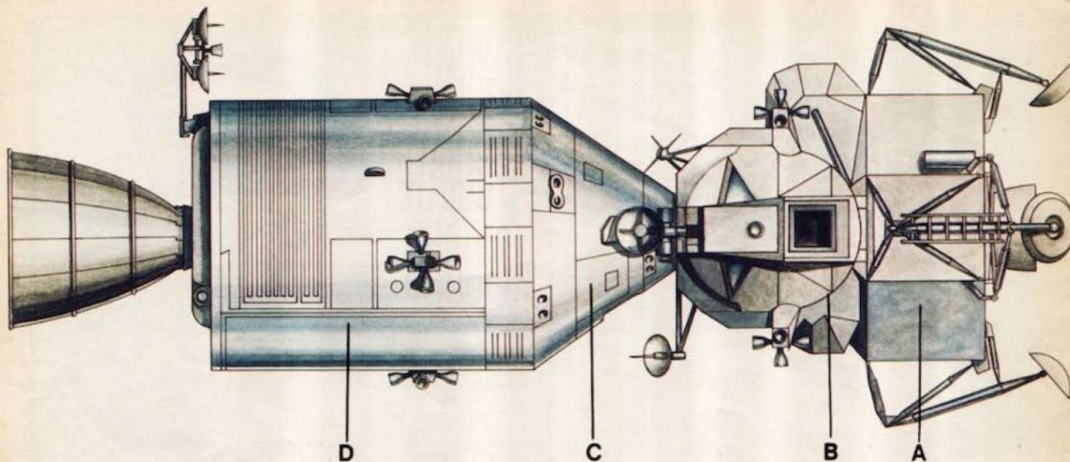
sea. And the sea mammoths which carry it are the largest man-made vessels afloat.

They carry millions of tons of fuel each year from oilfields in the Middle East and elsewhere to Europe. Most of the world's oil wells, other than those of the U.S.A. and Russia, are thousands of sea miles from the oil-using areas.

So, oil has to be moved either through a pipeline or in a tanker. Except in overland conditions which are particularly favourable to pipelines, tankers are best for long distances. They are cheaper than pipelines and can go where they are needed.

Today, one out of every six ships sailing





The rocket that took them into space was powerful and enormous. The vehicle that brought them safely back was little more than a midget.

When an explosion took place in the service module of Apollo 13 and destroyed its engine, it was only by the greatest good fortune that America's space mission was on its way to the Moon and not returning from it.

As we saw last week, if the crew had taken off from the Moon in the lunar excursion module *Aquarius*, having used its motor for descent and landing, the mission would have had no engine to blast the three astronauts out of orbit round the Moon and back on a course to Earth.

As it was, the comparatively small but powerful motor of the L.E.M. was sufficient to ensure the rescue of Mission 13.

With only a few small course corrections, the flight back to Earth went perfectly.

But it was not concern about the motor so much as other problems that worried the astronauts. The air they were breathing was one such problem. Stale air has to be "scrubbed" and used again, usually done by a chemical called lithium hydroxide which washes the air and stops the crew gassing themselves. But the system did not seem to be working properly.

To overcome this difficulty, the underwear of the astronauts was cut up under instructions from Houston and stuck together with sticky tape. After hours of "do-it-yourself", the crew managed to build an air cleaning system. Leaks were patched up with a sock, a towel and bits of sticky tape. It worked, it was a very near thing.

Another worry was the fact that the service module, where the explosion had occurred, was showing signs of breaking up. "Snowflakes"—possibly pieces of disintegrating material—passed the windows of the command module and the craft began to develop a wobble. Then a thump and other noises also strained the nerves of the crew.

All sorts of gimmicks and ideas poured into the control centre from the astronauts on the ground who worked on simulators and similar spacecraft to try and visualise what they would do in a similar situation. Their suggestions proved invaluable.

The guidance system, too was proving difficult, and the heat shield which would stop the crew frying on re-entry was possibly cracked.

Cooling water and drinking water was another problem. There was not enough of either, and the drinking water was possibly contaminated.

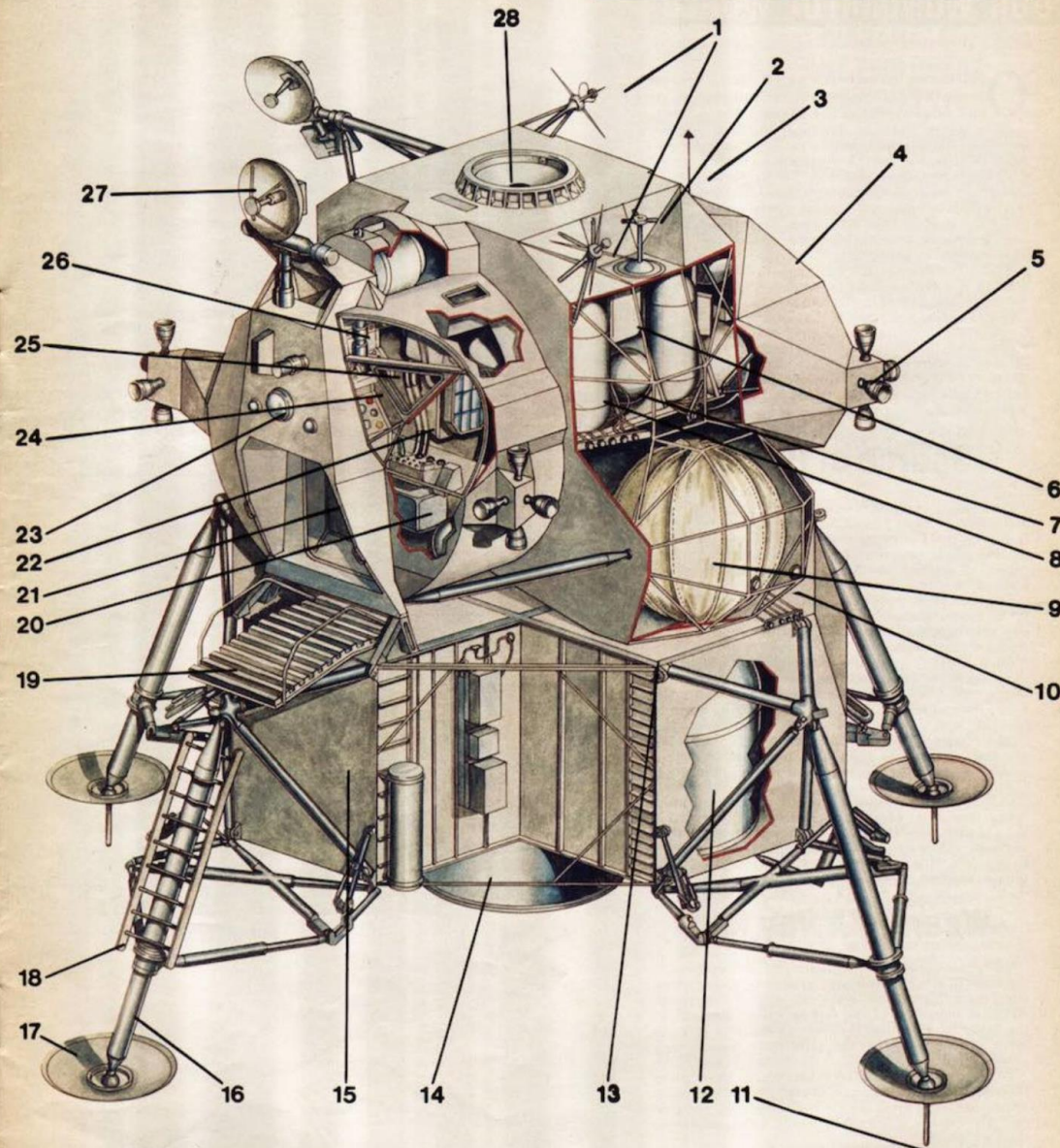
All the odds seemed stacked against Apollo 13 returning. But, as we now know, one of the world's largest T.V. audiences watched as the craft dropped through the clouds on its giant parachutes and splashed down just 600 miles from Samoa. After all they had been through, they were only five seconds late, and four miles from the point the computers said they would splash down.

This week, we take a look inside the mighty midget that saved the three astronauts—the first "lifeboat" in space.

Above: Apollo Spacecraft and Lunar Excursion Module in rendezvous position. A. Lunar excursion module descent engine and launch pad. This is the engine which was used to blast the "13" crew back to Earth. B. L.E.M. upper half, which the astronauts used to stay alive. C. Command module. D. Service module which went unserviceable because of an explosion.

LUNAR EXCURSION MODULE

1 Very high frequency antenna. 2 Docking target. 3 Extra vehicular activity antenna. Astronauts can talk from their space suits through radio contact, using this aerial, to Earth control and then to our radios and TV sets. 4 Aft equipment bay. 5 Reaction control assembly. These controllable rockets make the craft roll, move sideways, tilt or whatever the pilot dictates. 6 Assembly fuel tank. 7 Assembly helium tank. 8 Assembly oxidiser tank. 9 Fuel tank. The L.E.M. is split into two separate items. The top half takes off from the Moon with its own engine leaving behind the lower half. (See A and B—small illustration.) 10 Docking light. 11 Lunar surface sensing probe (on 3 of 4 undercarriage legs). These shut off engine when L.E.M. gets to within two feet of lunar surface. 12 Main engine fuel tank. 13 Lower half of L.E.M. (A on small illustration acts as launch pad when crew leaves Moon.) 14 Main descent engine skirt. 15 Oxidiser tank in this compartment. 16 Telescopic landing gear leg. 17 Landing pad. 18 Ladder. 19 Egress platform. 20 Water tank. 21 Main door. 22 Crew umbilicals. When operating, craft crew plug in to these tubes for all services: oxygen, electrical heating, etc. 23 Tracking light. 24 Control panel. 25 Window (2 more not seen). 26 Optical telescope. 27 Rendezvous radar antenna. 28 Entrance to L.E.M. when attached to command and service modules—as in small illustration.



THE FIRST 'LIFE BOAT' IN SPACE

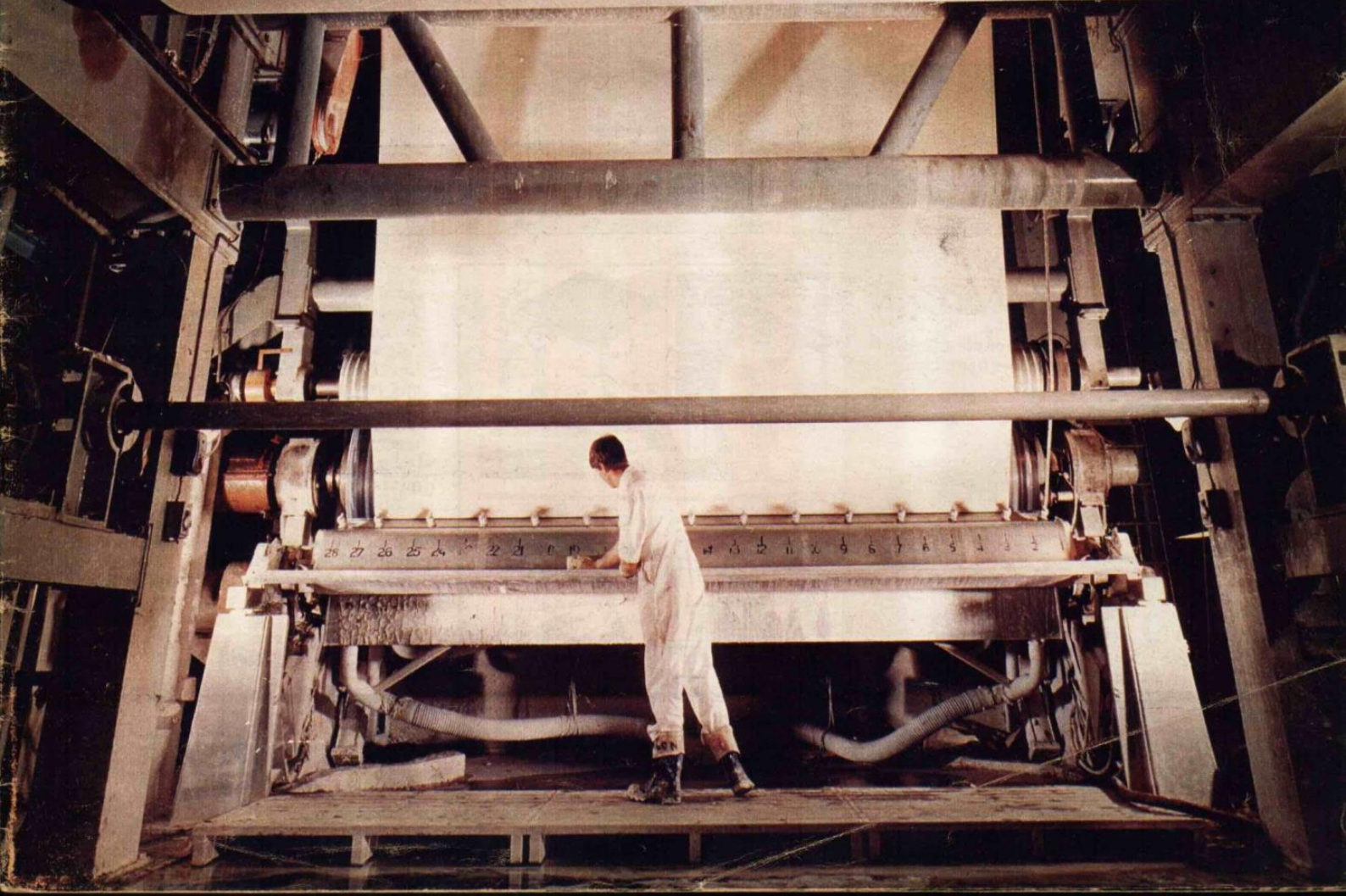
WORLD of WONDER

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THE STORY OF PAPER

SEE PAGE 3



TALKING POINT

We've explored the Earth and settled down there. We've been out into space and want a slice of the skies. So what's left?

Roughly seven-tenths of the total surface of the world on which we live is covered by water. Yet though the areas of our seas are so vast, their depths are but slight by comparison.

Despite this, Man's knowledge of what lies beneath the seas around him is still scarce. We know less about fish than we do about birds, less about the ocean depths than we do about outer space.

From ancient times men have wondered what the floor of the ocean might be like. But only gradually is our knowledge growing, based on observation instead of speculation.

The eating away by the sea of land masses—what we know as the gradual process of *erosion*—causes sediments to form beneath coastal waters. This underwater formation is known as the 'continental shelf' and may extend for hundreds of miles sloping only very gently to a depth of about 600 feet.

Beyond the continental shelf, however, the sea floor slopes more steeply to a depth of some two or three miles. Beyond this the ocean floor is flat though sometimes riven by great fissures known as *trenches*, the depths of which have yet to be explored in great detail.

These occur mostly in the Atlantic and Pacific Oceans and in the eastern parts of the Indian Ocean. Many plunge to a depth of four miles or more.

On the flat seabed there is no sediment at all. It is covered instead by the remains of seaplants and tiny sea animals and scattered with the skeletons of larger ones. Fish abound in every variety, from tiny ones no longer



In coming to terms with the world beneath the sea, Man has already planned his first underwater colony. Having been tested satisfactorily in the form of a large model, the full-scale version is likely to be built and occupied within about ten years.

It has been designed by one of the world's biggest industrial companies, General Electric of New York, who call it *Bottom Fix* because the whole city would be tethered to the ocean floor.

But it would not actually be built into the seabed in the way cities are built on solid foundations on the land. Instead the whole structure will be "neutrally buoyant" so that it will stay at a constant height just above the ocean floor, while anchored by a number of strong cables or chains.

The structure is built up from a lot of big hollow spheres like giant footballs, because the sphere is the ideal shape to resist the tremendous crushing pressure of the water deep in the sea.

The spheres that form the "houses" in the Bottom Fix city are built up on frameworks that have been made from a very strong, light metal called titanium which does not corrode in sea water.

Each sphere is made in the form of a lattice of titanium, while the spaces in the lattice, all pentagons, are filled by carefully sealing in a five-sided piece of curved glass ceramic made from a special material called Pyroceram, which is far stronger than ordinary glass.

A few gaps would either be filled by a titanium door, for entry and exit, or else connected to a five-sided corridor for joining to the next sphere.

Each sphere will be about three inches thick, and it will then have another, thinner sphere of glass-fibre and titanium built round it to provide additional protection.

What would a Bottom Fix colony be used for? First of all for scientific research of various kinds, including the taking of various measurements and all sorts of observation purposes at depths down to four miles.

Industry could later use such a base for mineral and seabed prospecting and for many tasks involving undersea instruments—cable and pipe laying, the recovery of sunken ships or equipment or for various industrial processes which, for reasons of safety or other factors, can be done better on the ocean floor than on land.

LIFE BENEATH THE SEAS

than a quarter of an inch to giant sharks 50 feet long, while in the darkest depths of the trenches lurk the mighty giant squids and other huge creatures.

Before the days of undersea exploration, it was always assumed that deepsea monsters would be hostile to Man, but experience has seldom shown this to be the case, though some of the creatures of the trenches, which seem to be all head and with jaws full of intimidating teeth, present a terrifying enough appearance. Many fish, however, do display as much curiosity about Man as he does about them, frequently crowding close to underwater divers, impeding their work.

First Forms of Life

Underwater exploration has allowed us to examine submarine fossils which have been able to tell us, in part, the history of life beneath the sea.

Nobody can be sure what produced the first spark of life, but it seems certain that minute forms of life first came into existence beneath the sea about a thousand million years ago.

The same fossils that tell us this also enable us to trace the development of those first single cell life forms to more complex multicellular ones. Other fossils reveal that what we call sponges, which are animals and not plants, were already in existence five hundred million years ago.

This was about the time that hard-shelled creatures, which had evolved from a wormlike organism, began to predominate in the underwater world. Another 250 million years were to pass before animals with backbones (called 'vertebrates') began to appear and, by a complicated process of evolution, eventually became the first recognisable fish. When some of these fishes developed lungs, they were able to come on to land periodically, and certain species were finally able to lead a completely amphibian life.

One of these early forms of fish life was the *coelacanth*, fossils of which have been found dating back 350 million years. It was long assumed to have been extinct until a living one was trawled from a depth of 40 fathoms in 1938 off the coast of South Africa. Another was caught rather surprisingly on a rod and line near the Comoro Islands, between Madagascar and the African mainland, in 1952. More were caught in 1953 and 1954 and all have been of a somewhat larger species than

the fossilised variety. The fact that this fish was for so long considered extinct underlines Man's lack of knowledge of the life of the depths.

Among the first men to set out to learn something about underwater forms of life was Charles Darwin, later author of the famous *Origin of Species*. Between 1831 and 1836 he sailed on H.M.S. *Beagle*, a survey ship, and throughout her round-the-world voyage Darwin collected and catalogued all sorts of underwater plants and animals.

About the same time, a young man called Edward Forbes was dredging up all manner of marine life from round the shores of the Isle of Man. He was eventually to write a book about his discoveries, though it was not published in his lifetime. However, his *Natural History of the European Seas* eventually became what is really the foundation of all our present day knowledge about marine life.

The history of Man's attempts to explore the depths of the seas is a fascinating study in itself—and one that we shall examine in a future issue.

But, for the purposes of this feature, it is sufficient to say that only in the last ten years or so has Man begun to realise the possibilities of underwater life.

He has been experimenting not only to see how deep he can go but also to see how long he can stay down.

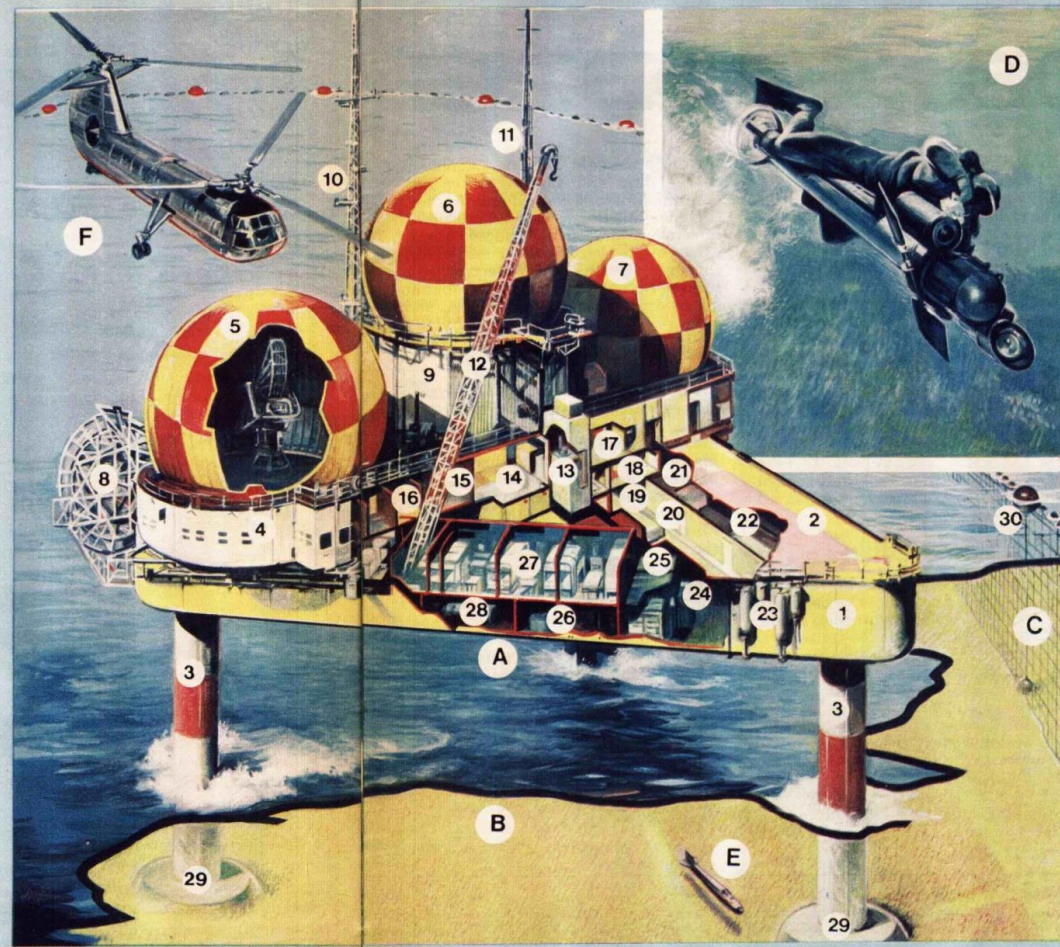
This really began because freedivers descending to 590 feet had to go through a lengthy decompression procedure which could last 12 hours and enable them to work only a few minutes a day.

Operation Sealab

If they could remain below water for several days, or even weeks, by providing them with all necessary amenities at the prevailing pressure, things would be changed, especially as it seemed that once the saturation of gas into the blood and tissues was complete there need be no further obstacle to remaining under water.

The first man to stay down as long as 25 hours was Robert Stenuit, a Belgian. That was in 1962, and two years later Stenuit again remained below, this time with Jon Lindbergh, for two days and two nights at a depth of 420 feet.

In the same year, the Americans mounted what they called their Sealab operations. Four men spent ten days underwater breathing instead of air a mixture of 80 per cent helium, 16 per



cent nitrogen and four per cent oxygen. During Sealab II, a team of ten men remained on the seabed for two weeks and were relieved by another team who also stayed down a further two weeks.

The underwater houses used in such experiments are becoming increasingly well-equipped and comfortable and the aim, which looks like being successful, is to set up stations at depths of up to 1,000 feet to better explore the lower limits of the Continental Shelf.

It seems more and more likely that Man who originally emerged from the seas may yet return to live there, conquering the limitations of Nature as inexorably as he has upon land.

ANYONE FOR SEAWEED?

Pessimists estimate that by the year 2000, there will be far too many people on Earth and not enough food to feed them. Such forecasts have been made before, and we have managed to survive. And, if the people who are investigating the possibilities under the sea have their way, we shall survive again.

Just in case these predictions about food shortage may come true (see *WORLD of WONDER* No. 8), scientists have been exploring the idea of

'harvesting' the sea. And before long, it seems, we shall all be eating seaweed!

Recent studies have shown that seaweed meal is even more nutritive than wheat. Moreover, it possesses various tastes. Some seaweeds, after cooking, taste very much like cheese, others like ham, and some like other meats.

It looks, then, as if we shall be seeing underwater ranches in the foreseeable future.

Seaweed fields will probably be cultivated on the continental shelves at depths of 50-130 feet, where men will be

THE SEAWEED FARM OF THE FUTURE?

An artist's impression.

- (A) Artificial island.
- (B) Seabed used for the cultivation of various species of seaweed.
- (C) Protective netting outside the underwater ranch.
- (D) The "sub-farmer"—an underwater version of the cowboy—will use a sort of compressed-air torpedo on his long tours of inspection.
- (E) A twin-place sub toolcarrier for plantation operations.
- (F) For communications between land and the artificial islands, helicopters will be used. For general transport purposes—such as fuel supplies, drinking water—ordinary surface vessels will be used.

- (1) Steel outer covering.
- (2) Landing deck for helicopters.
- (3) Tubular steel piles on which the artificial island stands.
- (4) Command bridge.
- (5-6-7) Protective plastic domes, extended and kept under pressure by hot air, and containing a complex radar system.
- (8) Radar for sea surface control.
- (9) Central command tower.
- (10-11) Radio aerials for various services.
- (12) Cranes for supplies.
- (13) Elevators for the three floors.
- (14-15-16-17) Rooms with electronic equipment, including complex computers.
- (18) Floor containing dining rooms, lounges and various recreational facilities (TV, cinema, discothèque, library, etc.). These are not visible in the illustration because they are concealed by overlying structures.
- (19-20) Writing and reading room and foyer.
- (21-22) Experimental station and biological laboratories for underwater crops.
- (23) Fuel and drinking water tanks. (Behind 1 and under 2 are large crude oil tanks.)
- (24) Diesel-electrical energy plants.
- (25) Storerooms for equipment and spares.
- (26) Drinking water.
- (27) Bedrooms.
- (28) Air-conditioning plant.
- (29) Solid base of support tubing.
- (30) Floats supporting the netting round the underwater plantation.

able to work without much discomfort.

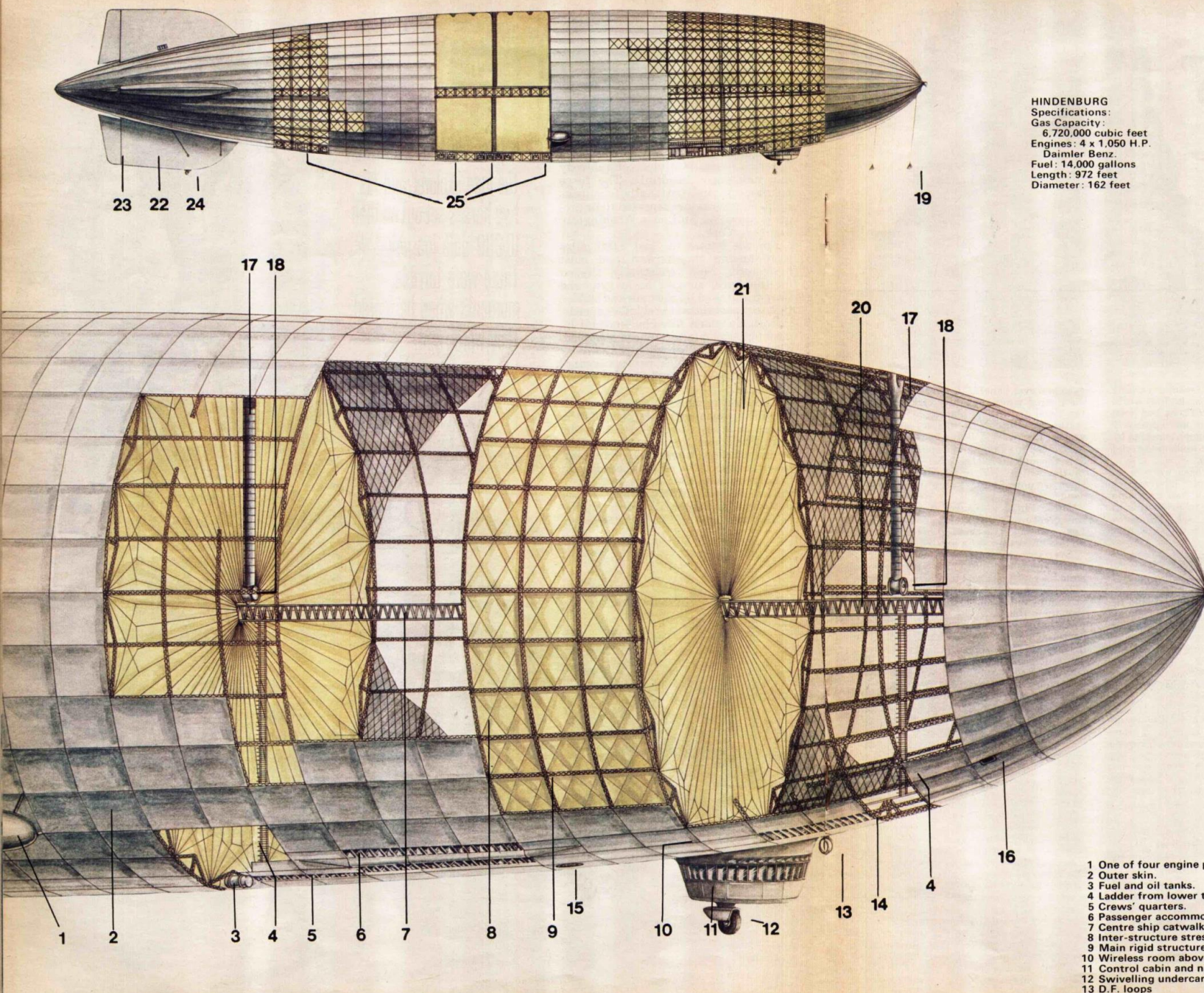
The underwater crop fields will be protected and separated by netting, which will prevent carnivorous fish from coming into contact with people, and also fence off one sort of seaweed from another.

Once subdivided into types and species, and provided with the natural temperatures in which they grow most spontaneously, it will be possible to calculate exactly the entire amount of harvests.

Seaweed and chips, sir?

FLYING CIGARS

HINDENBURG
 Specifications:
 Gas Capacity:
 6,720,000 cubic feet
 Engines: 4 x 1,050 H.P.
 Daimler Benz.
 Fuel: 14,000 gallons
 Length: 972 feet
 Diameter: 162 feet



One of the most awe-inspiring of man-made machines must have been the giant airships which were in service between 1900-1937. Developed first of all for war purposes, rigid and non-rigid airships were used by the navies of U.S.A., Germany, France and Britain. Their main function was sea reconnaissance, but during the First World War German Zeppelins bombed England. Although accidents and enemy action resulted in heavy losses, the Germans persevered.

Count Ferdinand von Zeppelin built his first airship in a floating shed on a lake near his home at Friedrichshaven in 1899. It was 420 feet long, 38½ feet in diameter and contained 400,000 cubic feet of hydrogen. Driven by two engines of only 15 H.P. it was hopelessly underpowered. L.Z.1 as it was called (Luftschiff Zeppelin 1) used money faster than gas and petrol and was broken up in 1901.

The year 1905 saw the Count at it again when L.Z.2 was built. On her second flight she was blown away by strong winds and after a safe landing was destroyed at her moorings. With his last money the once wealthy Count built L.Z.3 and at last convinced the German High Command of its military possibilities after a flight lasting eight hours.

The Count later formed Germany's first airline operating airships and by August 1914 more than 10,000 passengers had been carried 107,231 miles on 1,588 voyages.

The British had not been idle during this period, although they only had seven in commission at the beginning of the war. By 1918 over 100 were in use. Of these, the largest was the R.33 class, 643 feet long. The longest German airships during the war were 693 feet. Italy, France and America also had considerable numbers in service, although they were generally much smaller.

Regardless of the number of airships that crashed or burned without the help of bullets, shells, storms etc., the U.S.A., Germany and Britain continued to build airships. Those of Germany and Britain were for the rich Trans-Atlantic trade in passenger carrying, and in 1919 a British airship became the first to cross the North Atlantic. Improved engines and stronger structures led to the Germans and British building more comfortable and luxurious ships capable of carrying more passengers over greater distances. The "Flying Cigars" seemed here to stay.

However, the loss of the British R.101 at Beauvais in France in 1930 and many other near disasters started a general feeling against the airship. A structure the size of an ocean liner at the whim of wind and weather must have limitations and these showed up terribly in 1937 when the L.Z.129 *Hindenburg* exploded with terrible loss of life as it arrived in the U.S.A. after a Trans-Atlantic flight.

This put the seal on the death warrant of the airship as a passenger carrier. People saw the film of the *Hindenburg* burning, and that was that.

The Second World War saw limited use of "Blimps" as they were called, used for anti-submarine work off the U.S. coast. A U.S. Navy airship, Z.P.G.-2 holds the world record for staying aloft—cruising around for eleven days!

But the airship may not yet be dead. Even now a firm in the U.S.A. is looking into the possibilities of using a triple-hulled airship for cargo carrying.

- | | |
|---|------------------------------------|
| 1 One of four engine pods or cars. | 14 Officers' quarters. |
| 2 Outer skin. | 15 Searchlights. |
| 3 Fuel and oil tanks. | 16 Emergency water release. |
| 4 Ladder from lower to centre catwalks. | 17 Gas shaft/exit to atmosphere. |
| 5 Crews' quarters. | 18 Gas valve. |
| 6 Passenger accommodation. | 19 Retractable aerials. |
| 7 Centre ship catwalk. | 20 Forward catwalk. |
| 8 Inter-structure stress wires. | 21 Tangential stay wires. |
| 9 Main rigid structure. | 22 Fin. |
| 10 Wireless room above control room. | 23 Rudder. |
| 11 Control cabin and navigation room. | 24 Tail Wheel. |
| 12 Swivelling undercarriage. | 25 Fuel tanks all along underside. |
| 13 D.F. loops | |

WORLD of WONDER

EVERY MONDAY . PRICE 1/6d . No. 23 . 29th AUGUST 1970

Eire 1/10d Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d



FIRST OF A
NEW SERIES

**GREAT
BOOKS**

See page 6



TALKING POINT

WHAT NEXT ON THE MOON?

Hundreds of millions of dollars have been spent sending Man to his nearest neighbour in space. Will it all have been worth while?

Men first set foot on the Moon on 20th July last year. They planted a number of instruments, performed a few experiments, unveiled a plaque, gathered up as much lunar rock as they could carry and took off back to Earth.

Since then other astronauts have been to the Moon and all their conclusions have been the same.

The lunar environment is distinctly hostile, to us Earthlings at least. There is no air to breathe, no water, and consequently no living material that we could eat.

Perhaps there is some sense in quickly visiting the Moon to find out a great deal more about our nearest neighbour in space, and also to discover the answers to a lot of puzzles about our Solar System and even our own Earth. But what then? Will men just stop visiting the Moon?

After all, each trip costs hundreds of millions of dollars, and the US Government today is in a businesslike frame of mind that likes to see a return for its money.

Of course the answer could be "Yes, men will stop visiting the Moon." But

By the mid-70s, astronauts could be exploring the Moon's surface in an electric car. The tyres will be made of fine metal, as rubber would become brittle and shatter.

this will be the case only if the US and Russian leaders consider the matter very carefully and come to the conclusion that they can spend the money better in other ways.

At present it is difficult to be quite certain, but such a choice is unlikely.

Not only will men probably go on visiting the Moon, but they will probably make their visits longer and more varied. And ultimately they may build simple bases on the Moon where they can stay for days or even weeks.

Simple Bases

In some ways the situation resembles Man's first excursions into remote and unknown parts of our Earth. The first thing to be done then was to discover the new place and conquer it. And now this is the case with the Moon. The setting up of simple bases for exploration is exactly what is planned next.

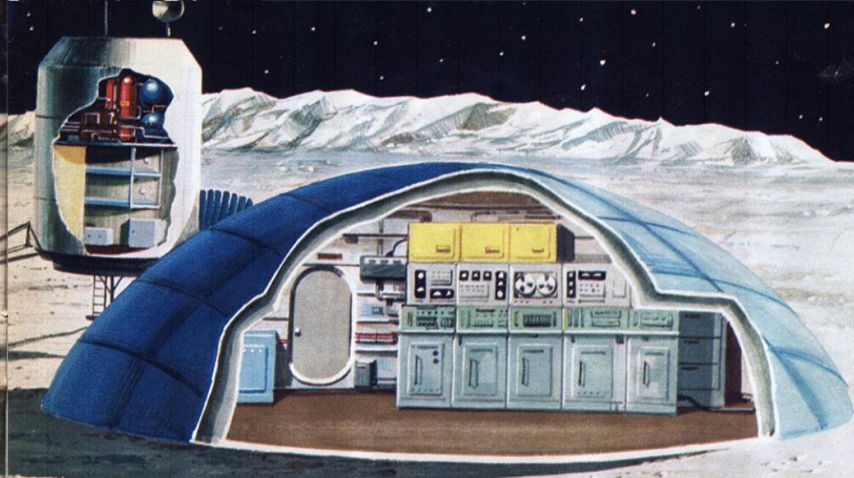
The US National Aeronautics and Space Administration (NASA) which runs all America's civil space programmes, has already spent millions of dollars designing lunar bases and even vehicles for exploring the Moon.

Vehicles? Don't forget, a man on the Moon has to tramp about in a heavy space suit and helmet and at the same time carry his life-support system to feed him with air and keep his suit comfortably air-conditioned. This means he has to support an Earth weight of about 220 pounds.

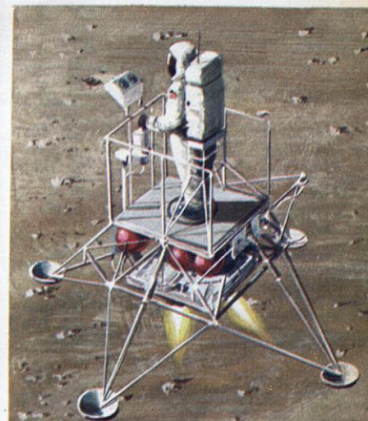
Thus burdened, he could hardly be expected to walk even a mile—and, although the Moon is smaller than Earth, there are many thousands of miles of surface to be explored.

The answer is to pack into the lunar rocket not only men but also vehicles.

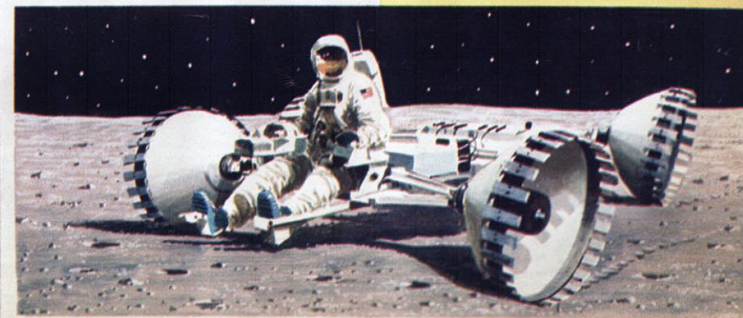
The lunar wheeled vehicles all have big springy wheels made out of thin strips or coils of steel (rubber pneumatic tyres would be difficult to use in the vacuum on the Moon) and they are all driven electrically. But there would be handicaps in driving on the Moon. Tests on Earth have shown that, even at a low speed of about 10 miles an hour, a lunar wheeled vehicle would bounce and float over the bumpy surface and



Designed to withstand extremes of heat and cold, this is what the first Moon base may well look like. The metal tower structures would house the vital life support systems and living quarters. The large plastic domes would house the survey and computer equipment.



A one-man rocket platform (above), as manoeuvrable as a helicopter, should be able to travel at a fairly high speed above the surface. Already being tested is this lunar roving vehicle (below). Powered by electric batteries, it should travel at about 10 m.p.h.





be impossible to stop suddenly, turn quickly or even control properly.

The other alternative is a lunar flyer, and the absence of an atmosphere means that instead of having wings it would have to be lifted as well as propelled by small rocket engines.

Lunar flyers look like a seat supported by three or four splayed-out legs. And considerable skill would be needed to fly one on the Moon without crashing. Moreover, if one did crash, even if the astronaut was quite unharmed, he would not be able to walk back again before his life-support system gave out.

Very careful precautions are being taken to find out how these lunar wheeled vehicles and flyers should best be used.

Moon Diamonds

On Earth, the most useful preparation for exploration of the Moon has been the construction of permanent colonies for the economic exploitation of the territory, that is if there is anything that could economically be brought back from the Moon. Even if the Moon were littered with diamonds, they would probably cost more to bring to Earth than it does to produce diamonds today!

But a permanent base on the Moon is

This is yet another one-man vehicle powered by electric batteries. Prototypes have already been built and trials conducted in the U.S. National Aeronautics and Space Administration (NASA) Moon surface simulator in Arizona.

almost a certainty for about 1980 or 1985. By this time NASA may have shipped many tons of building equipment, materials and auxiliary plant to the Moon.

The base would be built half underground, by digging out the soft rubble and dust on the surface. Then the permanent lightweight base could be erected quickly and coupled up with supplies of conditioned air, heating and cooling, running water, electricity and all other modern conveniences.

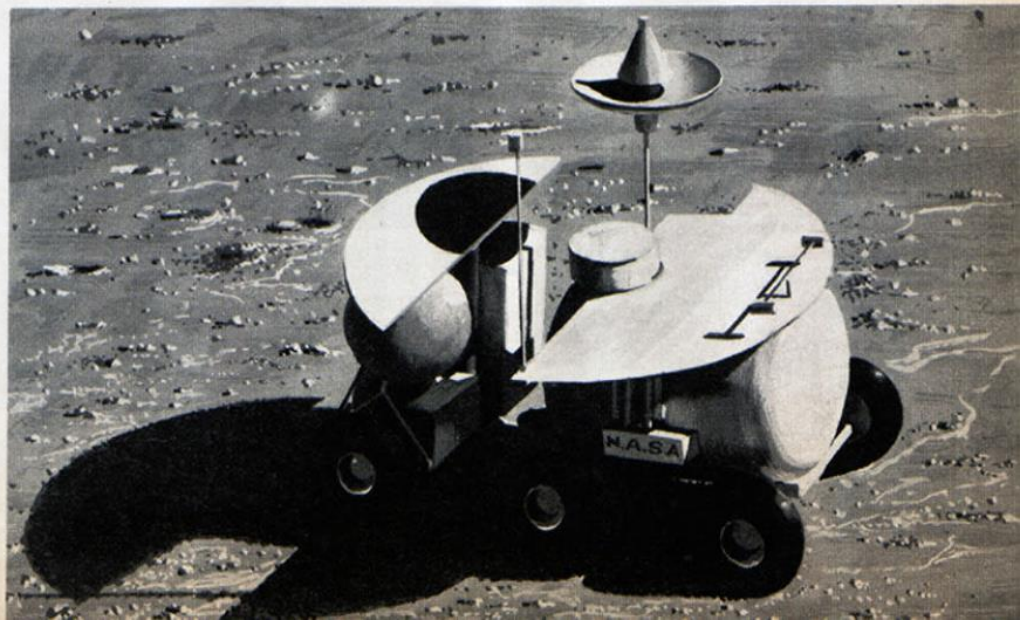
Inside the base, men who would probably be a mixture of scientists and

engineers would work in their shirt-sleeves doing research, looking after lunar vehicles and the base power supplies or just sleeping off duty.

They would need a "storm cellar" to which they could retreat whenever a storm on the Sun sent down showers of dangerous radiation (we on Earth are protected from such storms by our blanketing atmosphere), but otherwise life on the Moon could be made quite pleasant.

That a lunar base can be built is evident. This seems sufficient reason to ensure that it will be.

Shown here is a NASA design study for an unmanned survey vehicle. It is hoped that it will be capable of carrying out geological surveys directed from a Moon base by remote control.



World's Biggest Fire Engine for the World's Biggest Buildings

When the warning alarm is sounded in New York this giant goes into action, jetting water with the power of a cannon.

As everything in New York seems bigger than everywhere else in the world, it is only natural that the city runs the risk of bigger fires. With its many tall buildings there is a very special danger of fires being out of reach of conventional fire fighting equipment.

With this in mind, William Gibbs designed a mighty fire engine which makes all other fire engines look like toys. (William Gibbs, incidentally, is the man who designed the liner *United States*—with what must be the smallest quantity of wood of any ship afloat. Just 13 pieces, which happen to be butcher's blocks and pianos.)

His amazing fire fighting machine is powered by a British engine designed for high speed gunboats, motor torpedo boats and railway engines.

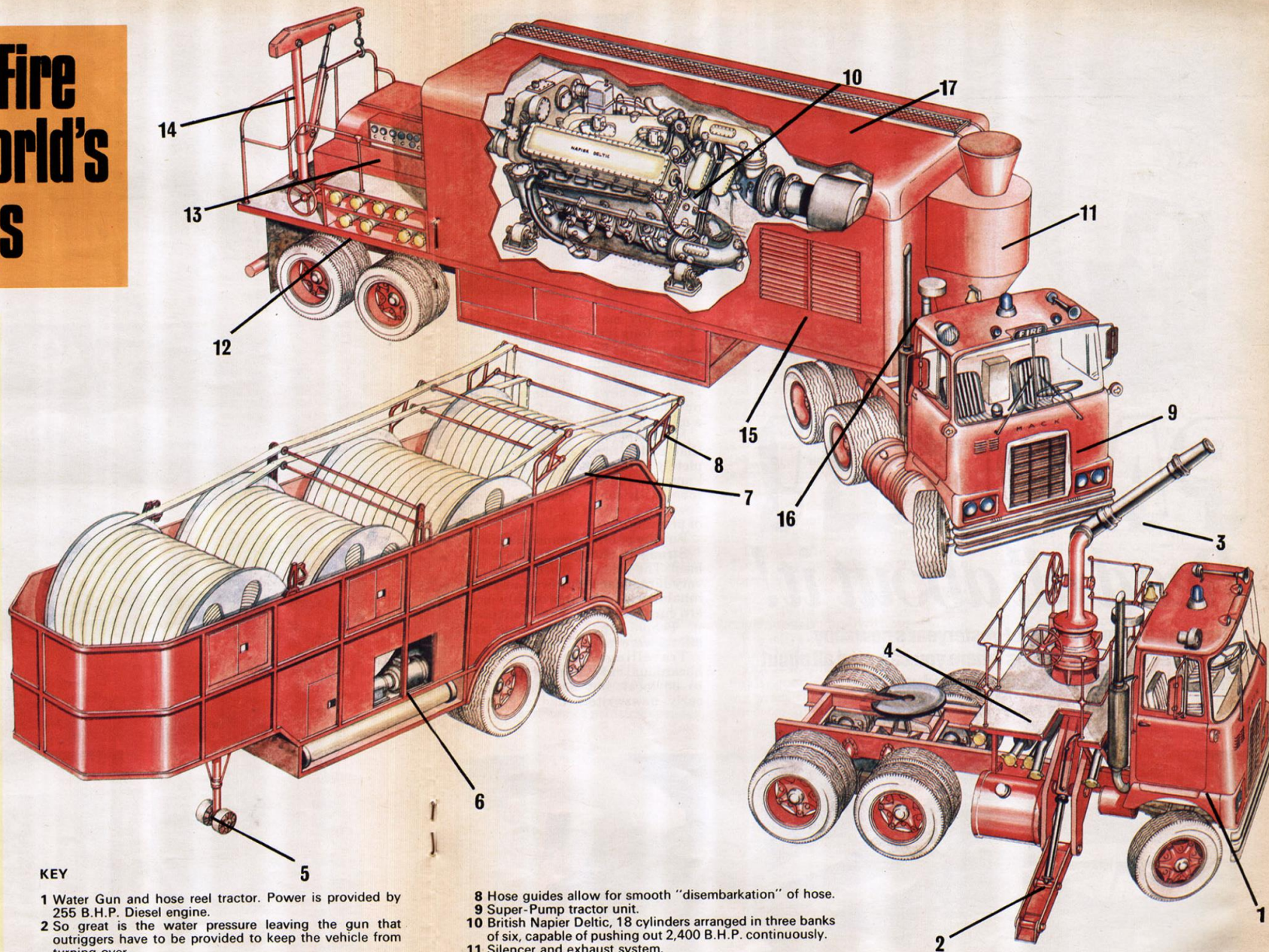
When a high-level fire is reported, the super-pump races to the scene. Some 1,500 feet short of the fire, the tractor towing the pump unit halts, out of danger of the fire, and connects up to four high-pressure water hydrants.

Meanwhile, the tractor towing the reels of hose approaches the fire, un-reeling the four hoses which have also been connected to the pump. The other ends are connected to the water gun.

Water from the hydrants passes into the pump and is forced through the four high pressure hoses to the water gun, which aims at the very heart of the fire—even if it is 1,300 feet up above the ground.

Water shooting out of the gun has the same muzzle velocity as a 75 mm artillery shell! At 1,100 feet the jet of water can punch holes through brickwork.

MARVELS OF OUR CENTURY



KEY

- 1 Water Gun and hose reel tractor. Power is provided by 255 B.H.P. Diesel engine.
- 2 So great is the water pressure leaving the gun that outriggers have to be provided to keep the vehicle from turning over.
- 3 Water Gun.
- 4 Control and operating platform.
- 5 Free-standing wheels on hose carrier, used when this part is abandoned at a fire.
- 6 Electric motors to drive reels.
- 7 Each reel contains 2,000 feet of high pressure hose.
- 8 Hose guides allow for smooth "disembarkation" of hose.
- 9 Super-Pump tractor unit.
- 10 British Napier Deltic, 18 cylinders arranged in three banks of six, capable of pushing out 2,400 B.H.P. continuously.
- 11 Silencer and exhaust system.
- 12 Hose connections.
- 13 Pump unit.
- 14 General purpose crane.
- 15 Air intake.
- 16 Engine exhaust.

SPECIFICATION

Each unit is 43 feet long, 11 feet 10 inches high, 8 feet wide and weighs 30 tons.

WORLD of WONDER

EVERY MONDAY . PRICE 1/6d. No. 24 . 5th SEPTEMBER 1970

Eire 1/10d Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d



MEN AGAINST A MOUNTAIN

*How the Mont
Blanc Tunnel
was built.
Story: page 19.*

TALKING POINT

How can 174 miles be knocked off the journey from Paris to Rome? Easily. By tunnelling through seven miles of solid rock. And how can that be done? Not so easily.

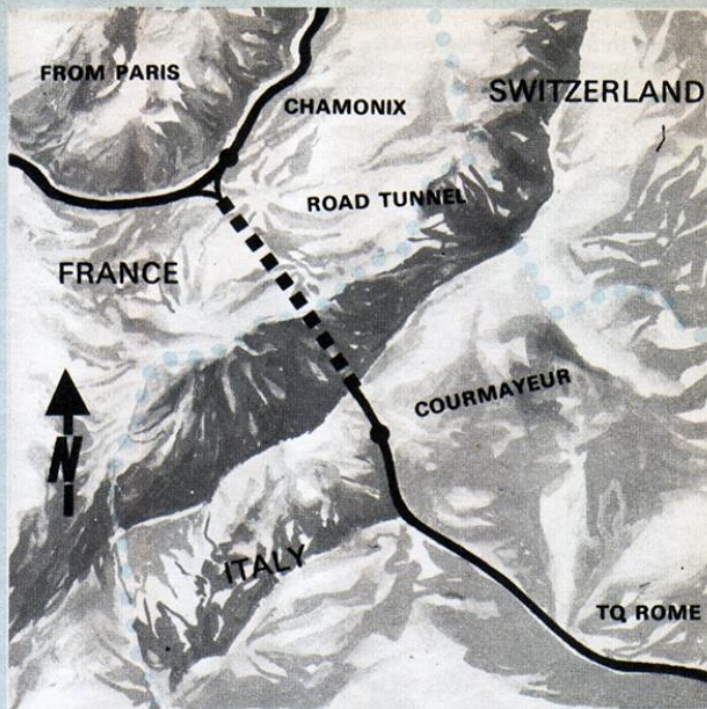
23 MEN DIED BENEATH MONT BLANC

Europe's greatest tunnel was very nearly dug by wool spinners from Turin. And perhaps it was just as well that they only *started* work on the fantastic project, for in view of the appalling difficulty of the task it seems unlikely that the worthy wool workers would have got very far without disaster overtaking them. Nevertheless, at the time—1946—it seemed a good idea.

As long as man could remember, it had been apparent that sooner or later someone would have to do something about Mont Blanc.

Nearly 16,000 feet high, the great, snow-capped mountain stands as a kind of natural barrier between Italy and France. As far back as Roman times, its icy slopes had been regarded with fear and hatred, and though time had banished the superstitious fear from people's minds, the sheer inconvenience of a 16-hour drive over the Alpine pass irritated both French and Italians alike.

And that was in good weather. Heavy snow closed the road completely for nearly six months of the year.



Work began on the world's longest road tunnel in January, 1959, and it was opened to traffic in July, 1965. Total cost of the tunnel was almost £23,000,000.

The man who decided to take the matter in hand was an Italian wool merchant, Count Dino Totino, and he was struck with the idea of building a road *through* Mont Blanc while travelling high above the mountain's slopes in a cable car.

As soon as he got within reach of a telephone, Count Totino, who was a man of quick decisions, put a call through to his factory at Turin and ordered all his workers to the town of Courmayeur. The project: to drill a tunnel all the way through to Chamonix, in France!

The astonishing thing is that the tunnel not only got started but was started with only the Count's money, without experienced help and—possibly most surprising of all—without government permission. All that summer Totino kept his men at work, until they had made a tunnel 150 feet long.



Shown here is the Italian entrance to the 7½-mile-long tunnel. Two weeks before the opening in July, 1965, sixty Alfa Romeo cars passed through testing out that the ventilation system effectively removed carbon monoxide.



It was at this point that the Italian and French governments stepped in. They admitted that the road through the pass was a nuisance to everyone. That so far as sheer usefulness was concerned, the tunnel was a magnificent idea. But what if France and Italy were at war? Might not the tunnel prove a military embarrassment?

In 1946, it was not so long ago that the two countries *had* been at war, so perhaps the politicians may be excused their sensitivity.

Not unnaturally, Count Totino laughed at their fears, pointing out that better communications between countries were more likely to improve trade than start fresh

wars. But the officials remained unconvinced.

It was not until seven years later that France and Italy agreed on a joint project. Tunnellers from the two countries would each start work on their own side of the mountain, and their governments would share the cost—some £20 million pounds.

Floods and Dust

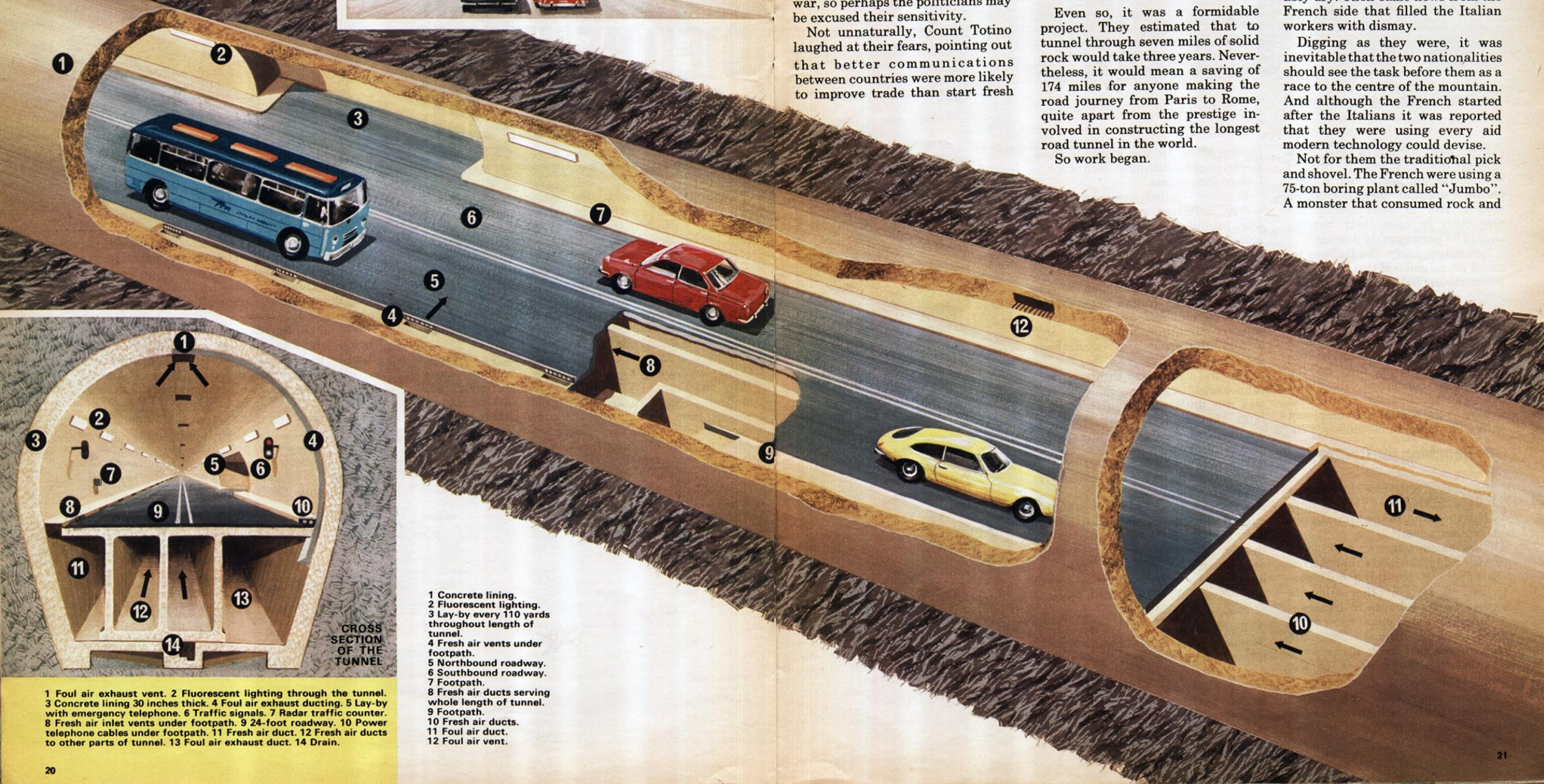
Even so, it was a formidable project. They estimated that to tunnel through seven miles of solid rock would take three years. Nevertheless, it would mean a saving of 174 miles for anyone making the road journey from Paris to Rome, quite apart from the prestige involved in constructing the longest road tunnel in the world.

So work began.

The original 150-foot bore had revealed nothing particularly dangerous, but once the tunnel approached the mile mark, trouble cropped up on the Italian side. An underground spring began to flood the workings, pumping 15,000 gallons of water a minute over the struggling men. Moreover, breathing was difficult as lungs panted in the dust laden air. Pumps were brought in to keep things reasonably dry. Then came news from the French side that filled the Italian workers with dismay.

Digging as they were, it was inevitable that the two nationalities should see the task before them as a race to the centre of the mountain. And although the French started after the Italians it was reported that they were using every aid modern technology could devise.

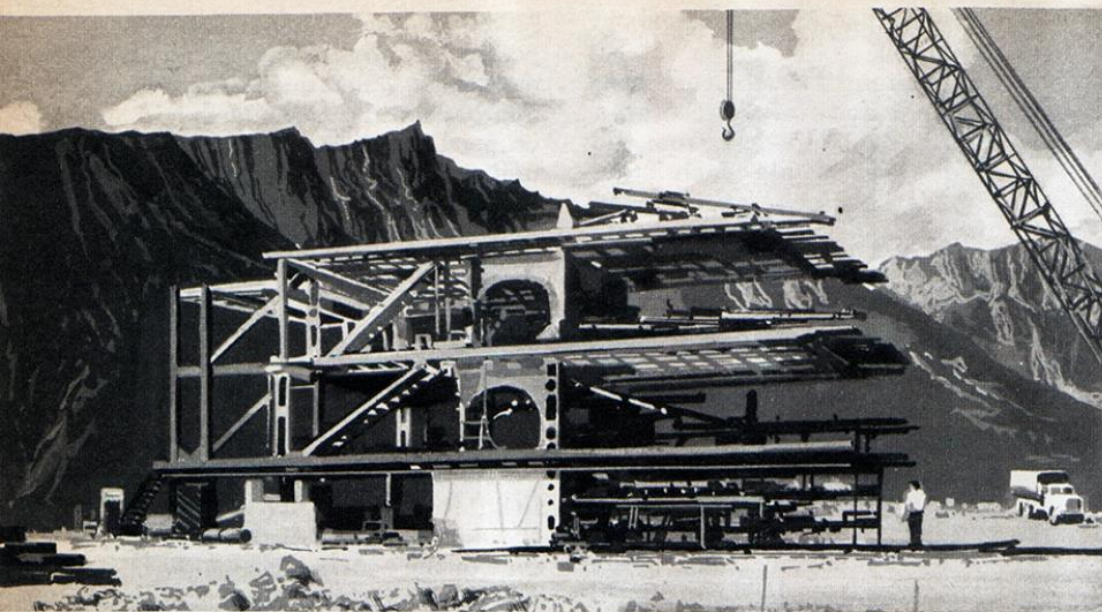
Not for them the traditional pick and shovel. The French were using a 75-ton boring plant called "Jumbo". A monster that consumed rock and



- 1 Concrete lining.
- 2 Fluorescent lighting.
- 3 Lay-by every 110 yards throughout length of tunnel.
- 4 Fresh air vents under footpath.
- 5 Northbound roadway.
- 6 Southbound roadway.
- 7 Footpath.
- 8 Fresh air ducts serving whole length of tunnel.
- 9 Footpath.
- 10 Fresh air ducts.
- 11 Foul air duct.
- 12 Foul air vent.

CROSS SECTION OF THE TUNNEL

1 Foul air exhaust vent. 2 Fluorescent lighting through the tunnel. 3 Concrete lining 30 inches thick. 4 Foul air exhaust ducting. 5 Lay-by with emergency telephone. 6 Traffic signals. 7 Radar traffic counter. 8 Fresh air inlet vents under footpath. 9 24-foot roadway. 10 Power telephone cables under footpath. 11 Fresh air duct. 12 Fresh air ducts to other parts of tunnel. 13 Foul air exhaust duct. 14 Drain.



Left: the 75-ton drill *Jumbo* used by the French. It is shown here assembled outside the northern entrance before its advance through the mountain.

Below: undoubtedly the greatest moment in the building of the Mont Blanc Tunnel. The Italian team enters the French half at noon on 14th August, 1962.

rubble like something out of a science fiction novel. It bristled with drills and made such a staggering noise that the men working near it had to wear special ear protectors in case their hearing should be permanently damaged.

Not surprisingly, the Italians insisted on a Jumbo of their own, and when it arrived the race for the centre of the mountain continued on a more even footing, although the expert in charge of the Italians, Professor Borie, made no secret of the fact that he considered the "race" a dangerous folly on the part of all concerned. He didn't care who reached the centre first so long as the tunnel was completed with a minimum of casualties.

Reaching the Centre

Surprisingly, despite the hazards involved, in the three years it took to drill the Mont Blanc tunnel, only 23 lives were lost.

Gouging out a maximum of 13 feet of rock a day, the men suffered from the effects of breathing dust particles and certain other ailments caused by long hours in bad conditions. But they kept at their work until, on 3rd August, 1962, the Italians reached the halfway mark and became the winners of the unofficial race.

Eleven days later the French workers blasted through the remaining ten feet of rock and the two

parties stood in the glare of the electric lights, staring at each other, face to face at last.

Emotion spilled over, and the weary, helmeted men rushed forward towards each other with cheers and embraced—friendly rivals who spoke different languages but shared the same skill and courage.

Seven thousand feet above them, the French and Italian flags were raised by climbers on top of the defeated mountain—two symbols of victory, fluttering bravely in the icy wind.

The first car passed through the tunnel on 16th August, 1962, but it was not until nearly three years later that this fantastic feat of engineering was ready for commercial use.

The sheer length of the tunnel had brought its own complications, demanding highly complex ventilating systems to extract the deadly carbon monoxide gas emitted by car exhausts. Because of this, and the fact that the tunnel was only wide enough for two lanes of traffic, not more than 400 cars an hour were allowed to pass through at a speed limited to 30 m.p.h.

In 1965, a fleet of 60 Italian Alfa Romeo cars drove steadily between Chamonix and Courmayeur and the air pollution was carefully measured. The huge air extractors worked perfectly.

Count Totino's dream was a reality at last.



WORLD of WONDER

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Eire 1/10d Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d



THE CONQUERORS

Great new series
begins this week.
Story: page 3

THERE ARE GIANT SERPENTS IN EVERY SEA

Ever since Aristotle wrote of strange animals in the ocean, round and long like beams of wood, men have wondered whether the sea hides huge creatures that dwarf even the dinosaurs of the Reptile Age.

For a long time seamen's tales of huge creatures that coiled themselves on top of the water were dismissed as travellers' tales, but then a ship's captain whose honesty could not be doubted and who stood to lose his career if he lied, reported to the Admiralty that he had seen a serpent-like monster in the South Atlantic. He was Captain M'Quahae of H.M.S. *Daedalus*.

The creature he and his witnesses so ably described has become enshrined in history as the Daedalus serpent. And from that day, in 1848, eminent men have become more and more inclined to believe that there may be some truth in the sailors' stories.

What the *Daedalus* men saw was a huge serpentine head raised four feet out of the water. The part of its body visible above the water line measured a good 60 feet. Its real length they could not estimate as it was hidden underwater. Around the neck, about 15 to 16 inches in diameter, was a mane of tangled hair "like a horse's".

When the creature finally disappeared, after coming within 200 yards of the ship, the astonished sailors had been able to watch it through telescopes for a full 20 minutes.

The Atlantic is not the only ocean that sometimes reveals a glimpse of a leviathan body. The seas around the British Isles and the North Sea also seem to harbour a number of enormous animals.

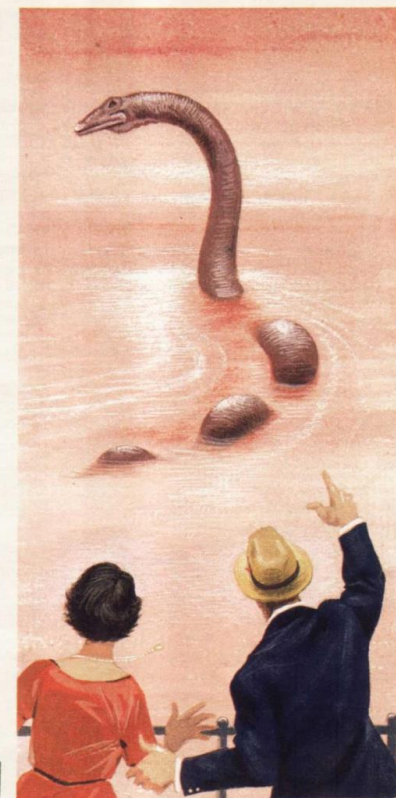
The most recent sighting, in 1966, was near Skegness when a Mr. George Ashton and his wife noticed what at first seemed a large log floating less than 100 yards offshore. Only when they realised it was moving at about eight m.p.h. parallel to the shore, as no log could ever do, did they look more carefully. George

Or are there? Should we believe stories of fantastic creatures that lurk in the depths? Or should we dismiss them as exaggerated travellers' tales?

Ashton thought then that it might have been a submarine, but suddenly a long, snake-like neck and head rose above the water.

Amazed, they stood and watched as a creature they both thought was not supposed to exist swam steadily away from them. Its body, which showed only as five or six humps above the water, exactly fitted the traditional description of a sea serpent.

Most witnesses, when they have recovered from the shock of seeing a creature as large as a house, report seeing a long row of humps and most often a long snake-like head. This is the reason these enormous animals have been called sea serpents. However, it seems more likely that they are not serpents at all but thick-bodied animals with long necks and tails. *Continued on next page*



As recently as 1966, an enormous "monster" with a snake-like neck was sighted less than a hundred yards from the shore of Skegness. It exactly fitted the traditional description of a sea-serpent and added more support to the stories that generation after generation of seafarers have told.



What did the U-boat's

In 1915, a German U-boat had torpedoed a British steamer which sank immediately. Beneath the water, the ship exploded hurling up wreckage—and also the 60-foot body of a strange crocodile-like creature! There were similar incidents in the heavily-mined areas around the Orkney Islands during the Second World War. On a couple of occasions, mines suddenly exploded and shortly afterwards the mutilated remains of huge "sea-serpents" were reported nearby.

Certainly the Frenchman who was out for a day's boating off Api in the South Sea was panic-stricken when a huge serpentine head and neck suddenly reared itself from the water close alongside. However, though the "monster" towered over his little boat, the man was still collected enough to notice it had a mane of hair, something no reptile could ever have.

Many witnesses say that the creatures they saw, while being un-named, were nothing like serpents.

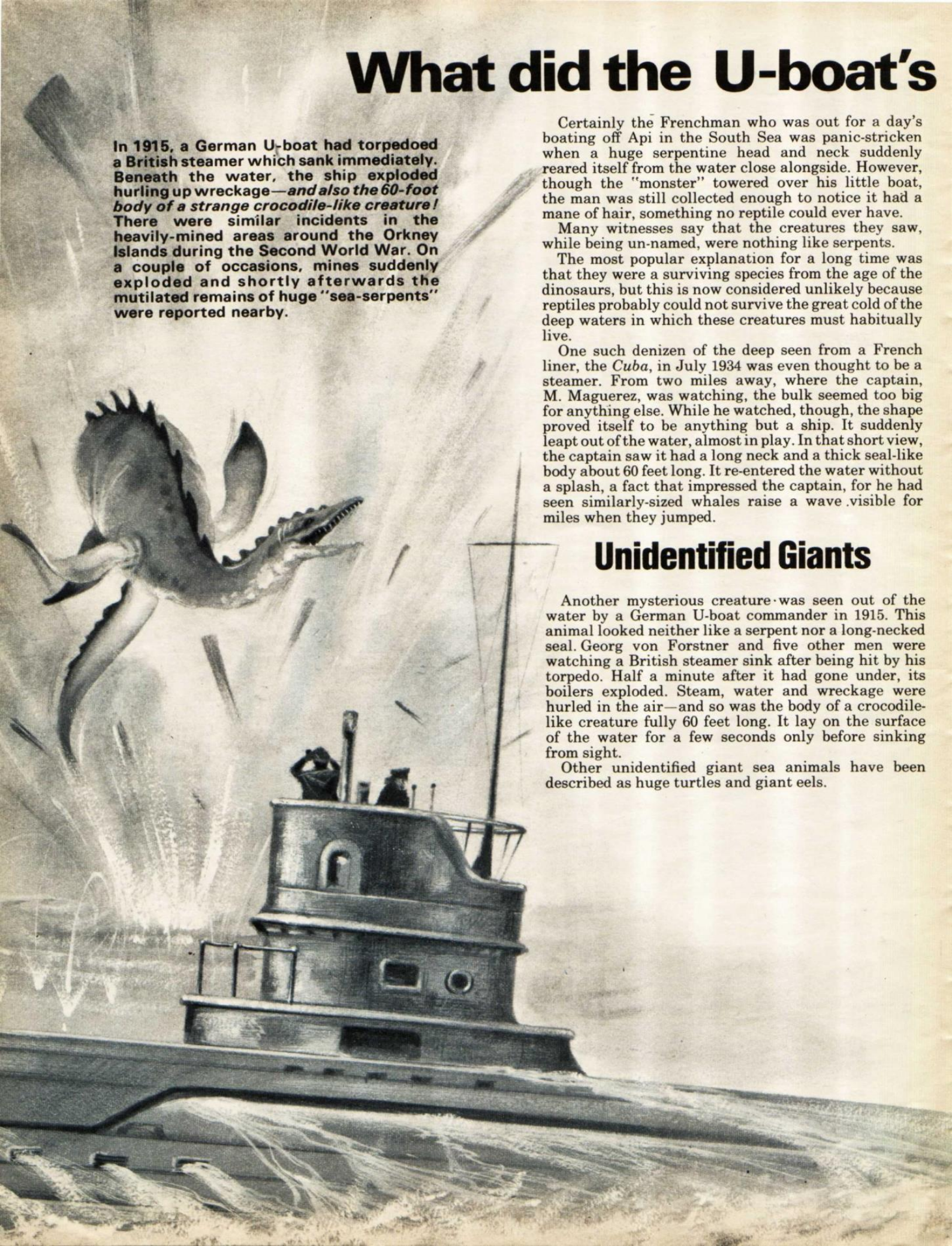
The most popular explanation for a long time was that they were a surviving species from the age of the dinosaurs, but this is now considered unlikely because reptiles probably could not survive the great cold of the deep waters in which these creatures must habitually live.

One such denizen of the deep seen from a French liner, the *Cuba*, in July 1934 was even thought to be a steamer. From two miles away, where the captain, M. Maguerez, was watching, the bulk seemed too big for anything else. While he watched, though, the shape proved itself to be anything but a ship. It suddenly leapt out of the water, almost in play. In that short view, the captain saw it had a long neck and a thick seal-like body about 60 feet long. It re-entered the water without a splash, a fact that impressed the captain, for he had seen similarly-sized whales raise a wave visible for miles when they jumped.

Unidentified Giants

Another mysterious creature was seen out of the water by a German U-boat commander in 1915. This animal looked neither like a serpent nor a long-necked seal. Georg von Forstner and five other men were watching a British steamer sink after being hit by his torpedo. Half a minute after it had gone under, its boilers exploded. Steam, water and wreckage were hurled in the air—and so was the body of a crocodile-like creature fully 60 feet long. It lay on the surface of the water for a few seconds only before sinking from sight.

Other unidentified giant sea animals have been described as huge turtles and giant eels.



torpedo kill?

As instruments for scientific research become ever more sophisticated, the science of zoology has been able to widen its once rigid borders. Two sea creatures which were said to be myths when the captain of the *Daedalus* gave his official report to the Admiralty have now been proved to exist.

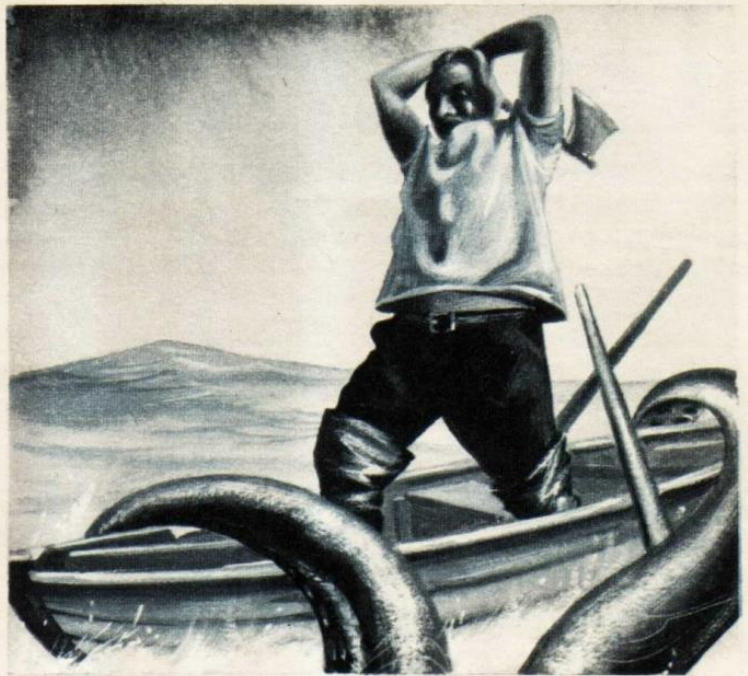
One is the *Kraken*, the terrible beast of Norse legend which was said to wrap its arms round small boats and pull them under. It was also said to be so big as to be mistaken for a small island by the unwary. The Kraken, or rather the beast on which the legend was founded, has since been identified as a species of colossal squid.

Legend of the Squid

A number of dying squid were found on the Atlantic coasts during the closing years of the last century. Not all were dying, however. True to legend, one did attack a fisherman in his small boat. In this case, the squid came off worst, losing a tentacle in the encounter. When examined, the preserved paddle on its tip was a little larger than that of the average squid, which showed that the fisherman had not been exaggerating. Then, too, from sucker marks on whale skins, it has been estimated that there are giant squids at least 150 feet long somewhere under the sea.

The other creature hauled up from legend and into the light of day, looks at first sight more like a true "sea serpent", though it could never show the characteristic coils of the legendary beast. In 1930, a Danish research ship, the *Dana*, trawled up a baby eel six feet long in the South Atlantic, an area where many sea serpents have been sighted. In the more common types of eel, their young at the same stage of development are never more than three inches long. The discoverer, Dr. Bruun, estimated the adult eel would be between 30 and 65 feet and could weigh as much as 25 tons. Enough to keep half of Bradford in jellied eels for a week!

Gigantic eels of this sort could well be responsible for many sightings in the Mediterranean, but for the rest—we'll have to wait and see!



Many fishermen have testified that giants of the deep have loomed before their boats and sometimes attacked. These men survived to talk of their experiences. How many didn't?



IS THIS ONE POSSIBLE EXPLANATION?
The *Tylosaurus*, 50-60 feet long, existed 60 million years ago. Could it be that it is not extinct?

It moves underwater with periscope raised, then its ballast is expelled and the craft surfaces. Its water skids are drawn back and a powerful turbojet pushes it towards the skies. Then its skids come out again, it touches down on the surface again and floats for a moment as it takes in water (ballast) before submerging.

HERE COMES THE FLYING SUBMARINE

A submarine that flies has long been a popular favourite in comic stories and on children's television programmes. It is very simple to write one into a script, then ask an artist to illustrate or a puppeteer to manipulate one. But how on earth do you make the real thing?

This problem has fascinated men for many years, and several nations have wrestled with the idea of producing a craft that could fly, float, submerge, surface, take off and fly again. It was a difficult problem to solve—for obvious reasons.

A submarine must be waterproof, airtight and have special engines to drive it along beneath the waves. Also it is usually heavy.

On the other hand, a plane needs to be sleek and fairly lightweight, and certainly there has never been designed an aeroplane with watertight engines.

What was right for a submarine, it

seemed, was anything but right for a plane.

However, something that can sort out the contradiction in designs is at last in the wind—and the water.

In recent years, an enormous amount of research has been put into the American space programme, and many new techniques and materials have been developed.

Sensational Craft

An American engineer by the name of Donald V. Reid has borrowed some of these latest ideas and developments from space—in particular an improved engine design and a new highly resistant lightweight material—and has constructed the prototype of an aeroplane that can both fly and travel under water.

As yet, it's all very secret. Not even for *WORLD OF WONDER* are the Americans going to divulge the actual 'ingredients' of this sensational craft. All the technical data is being kept very close to the chest, though since this is usual in the case of all

new aircraft, it is even more to be expected in the case of such a revolutionary concept.

The greatest value of such a craft would without doubt be military, for with such a machine a pilot could carry out the most effective of surprise attacks.

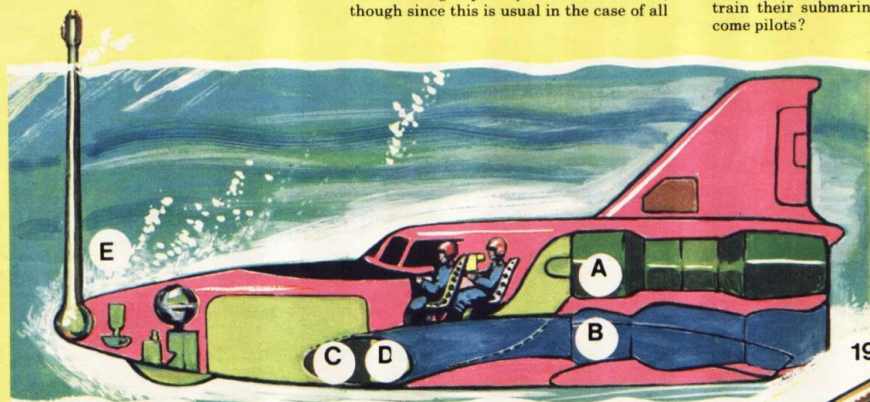
He could approach his target under the water, make a sudden unexpected take-off, strike and immediately afterwards submerge and be reasonably safe from counter-attack.

At present, forecasts for this submarine aircraft are that it will fly at about 500-550 mph and be able to travel at some 20-25 mph underwater.

Scientists in the Soviet Union are also working feverishly to turn out a similar multi-use plane.

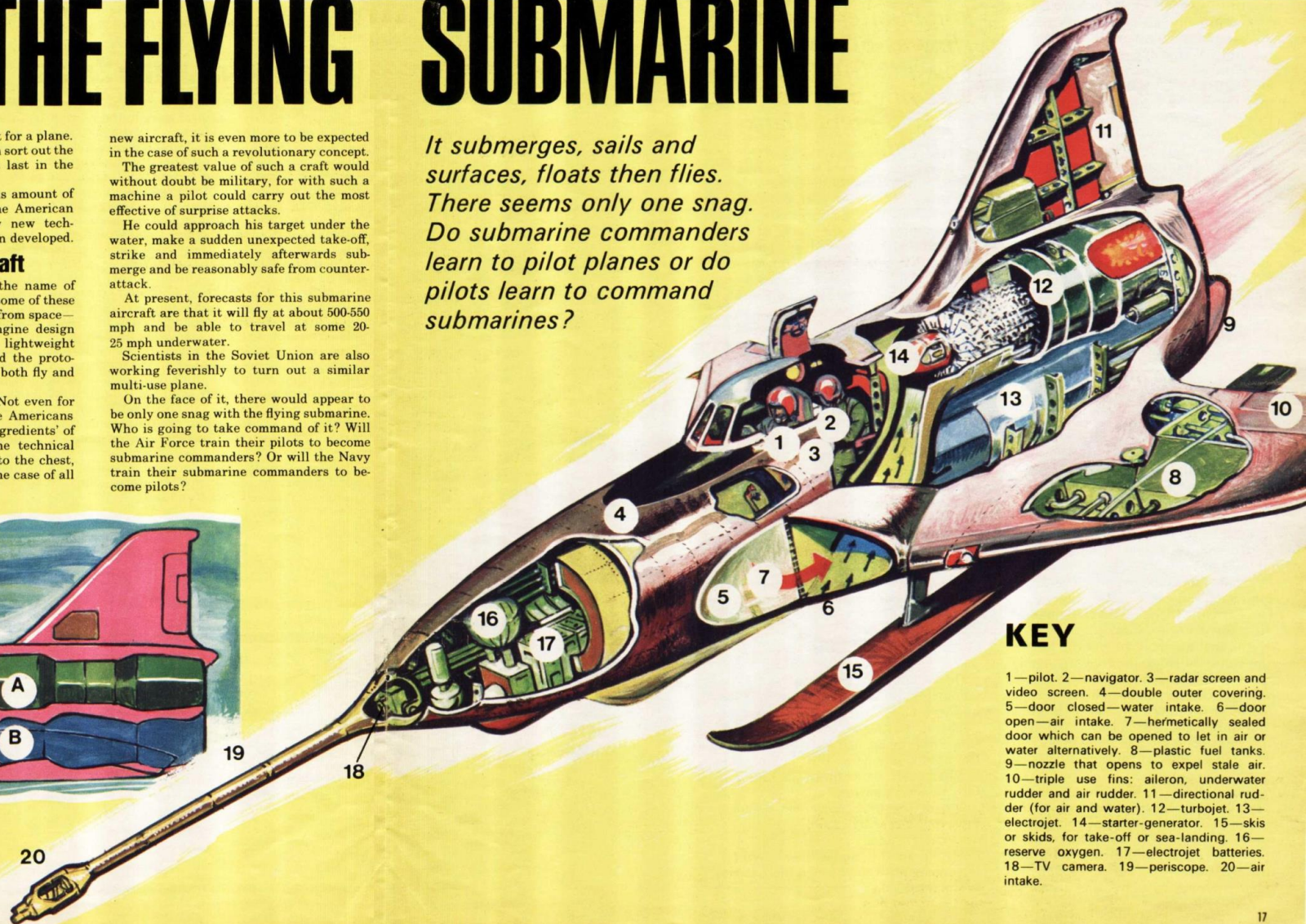
On the face of it, there would appear to be only one snag with the flying submarine. Who is going to take command of it? Will the Air Force train their pilots to become submarine commanders? Or will the Navy train their submarine commanders to become pilots?

It submerges, sails and surfaces, floats then flies. There seems only one snag. Do submarine commanders learn to pilot planes or do pilots learn to command submarines?



HOW IT NAVIGATES UNDERWATER

- A—turbojet
- B—electrojet
- C—air intake—with door closed
- D—air intake open for the electrojet
- E—periscope extended for navigation underwater



KEY

- 1—pilot. 2—navigator. 3—radar screen and video screen. 4—double outer covering. 5—door closed—water intake. 6—door open—air intake. 7—hermetically sealed door which can be opened to let in air or water alternatively. 8—plastic fuel tanks. 9—nozzle that opens to expel stale air. 10—triple use fins: aileron, underwater rudder and air rudder. 11—directional rudder (for air and water). 12—turbojet. 13—electrojet. 14—starter-generator. 15—skis or skids, for take-off or sea-landing. 16—reserve oxygen. 17—electrojet batteries. 18—TV camera. 19—periscope. 20—air intake.

Exciting Stories of our Exciting World

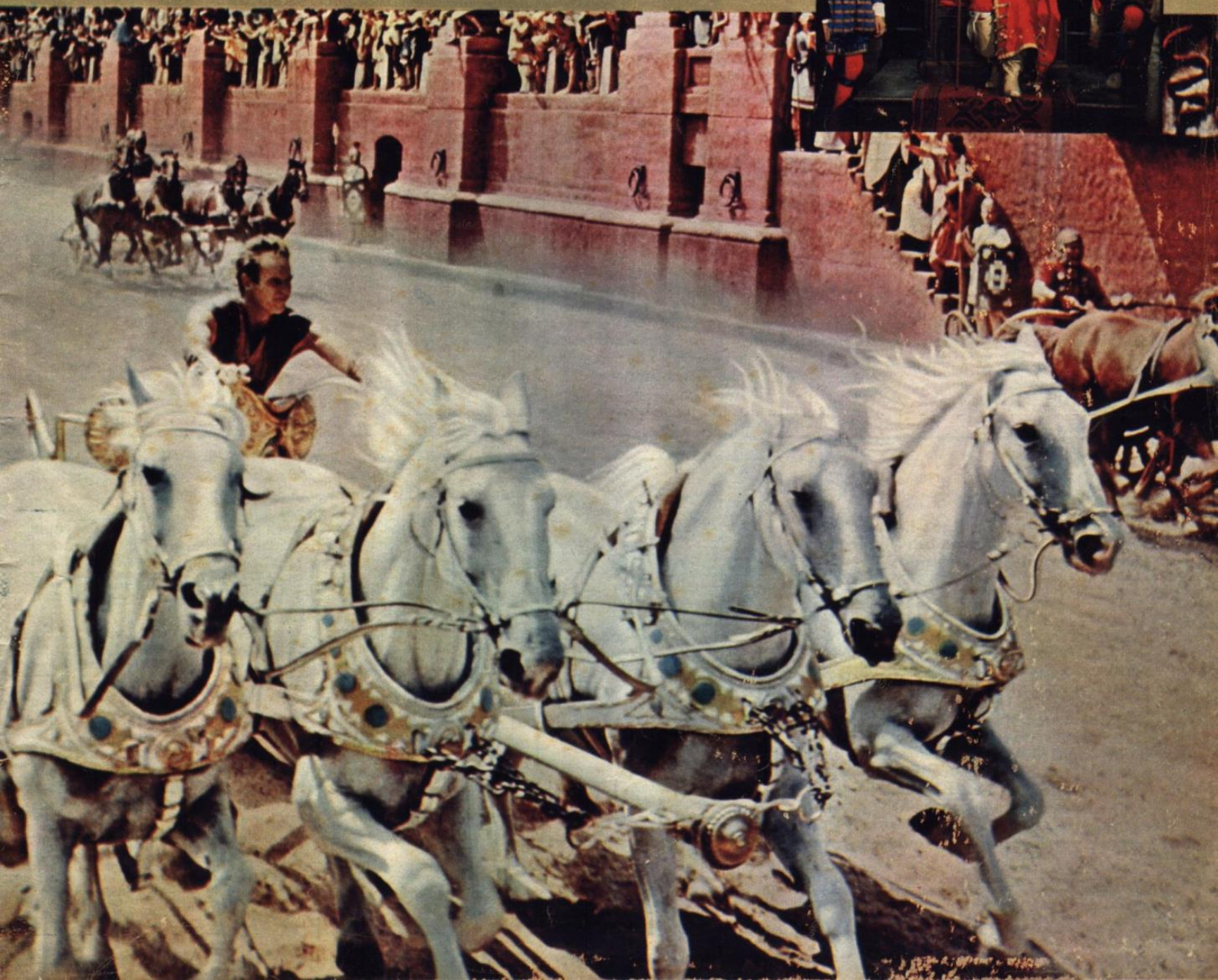
WORLD of WONDER

EVERY MONDAY . PRICE 1/6d. No. 28 . 3rd OCTOBER 1970

Eire 1/10d Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d

COLOUR COMES TO THE CINEMA

The great and glorious
epics of the wide screen.
Story: Page 20



SEARCHER on the SEA BED

The submarine with a "nose" for treasure and a "hand" that can pick it up.

A few weeks ago we were talking of the treasure which lies on the bottom of the sea all over the world, deposited there by hundreds of ships which sank in battle or violent storms.

Some of these ships are hundreds of feet below the waves and quite inaccessible. Others broke up in comparatively shallow areas. But even in the shallow waters round our coasts the treasure is not just lying there waiting to be picked up. It must be searched for.

The submarine on this page has been designed to do just that. It is the *Star IV*, the fourth in a series built by General Dynamic Electric for scientific exploration and archaeological research.

Powered by electricity, *Star IV* can move along the surface at five knots. When the pilot wishes to submerge, he opens the valves and the weight of water entering the ballast tanks forces the vessel down. To resurface, the water is forced out by compressed air.

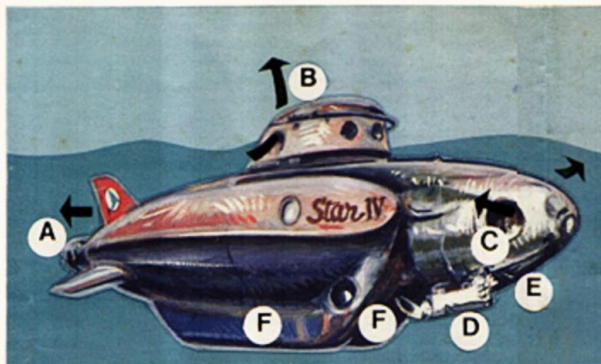
Inside his pressurised cabin, the pilot gets a clear view all round through portholes and TV cameras in the nose and conning tower. A powerful headlight provides illumination when the vessel enters the darker depths.

Hidden In the Sands

Most of the treasure and remains of ships are likely to be hidden under a layer of sand or silt, and so a special electro-magnetic detector is fitted. In much the same way as a soldier sweeps an area suspected of being mined by the enemy, so the detector sweeps the sea bed. It is so sensitive that even a single gold coin will be revealed.

Once an object is discovered under the sand, the pilot can pick it up by means of a pincer-like grab on the end of an extendible arm, normally retracted when not in use.

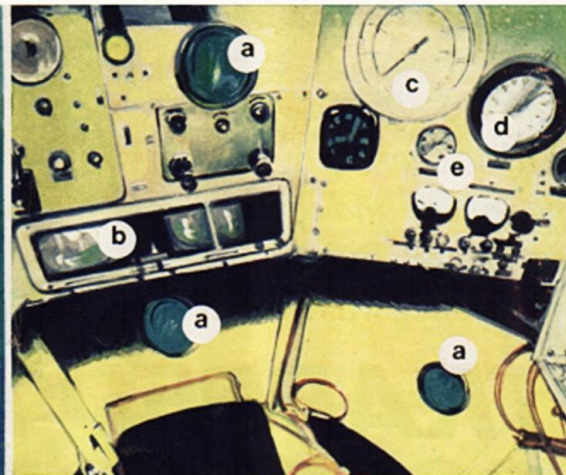
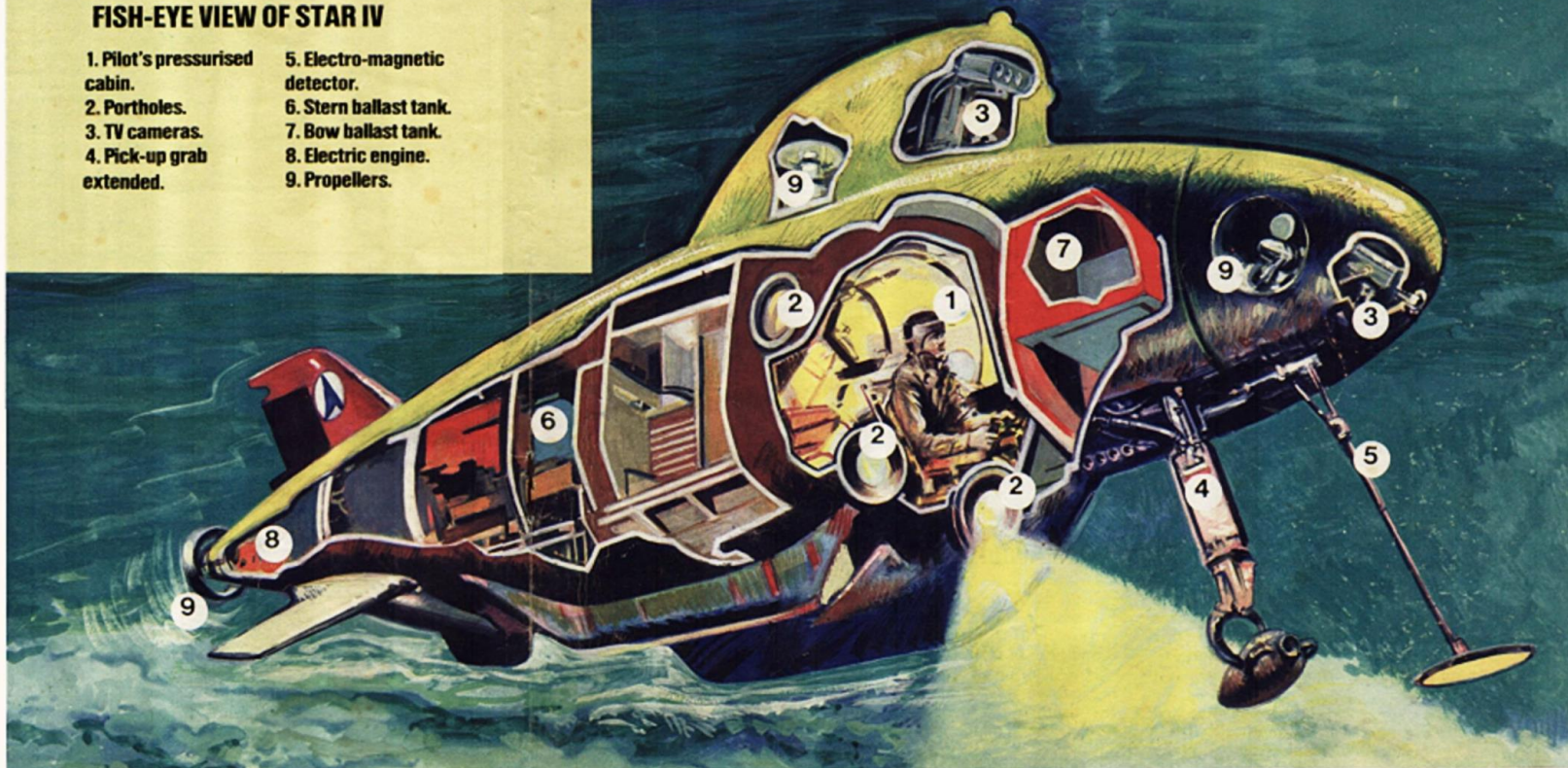
The *Star* has three propellers, all operating independently or in conjunction. The one in the tail drives the vessel forward, one in the conning tower enables it to "hover" over a discovery, and one on the side means that it can rotate on its own axis.



A, B, C. Three propellers working independently of each other. D. Pick-up grab for recovering items found on the sea bed—shown in the retracted position. E. Electro-magnetic detector, also retracted. F. Compressed air tank.

FISH-EYE VIEW OF STAR IV

- | | |
|-------------------------------|-------------------------------|
| 1. Pilot's pressurised cabin. | 5. Electro-magnetic detector. |
| 2. Portholes. | 6. Stern ballast tank. |
| 3. TV cameras. | 7. Bow ballast tank. |
| 4. Pick-up grab extended. | 8. Electric engine. |
| | 9. Propellers. |



Interior of the pilot's cabin with main control instruments. a. Porthole. b. TV screens. c. Depth indicator. d. Pressure indicator. e. Engine controls.

Exciting Stories of our Exciting World

WORLD of WONDER

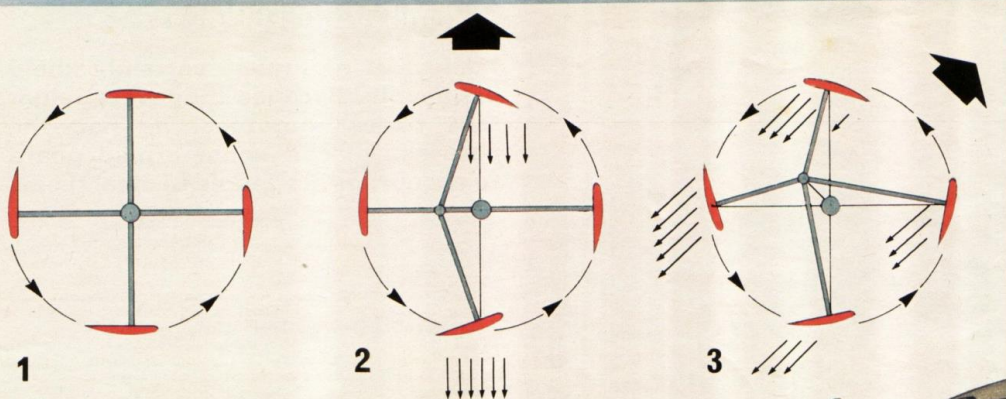
EVERY MONDAY . PRICE 1/6d. (7½ New Pence) No. 29 . 10th OCTOBER 1970

Eire 1/10d (9½ New Pence) Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d

**WAS MARIE ANTOINETTE SEEN
AT VERSAILLES IN 1901?**

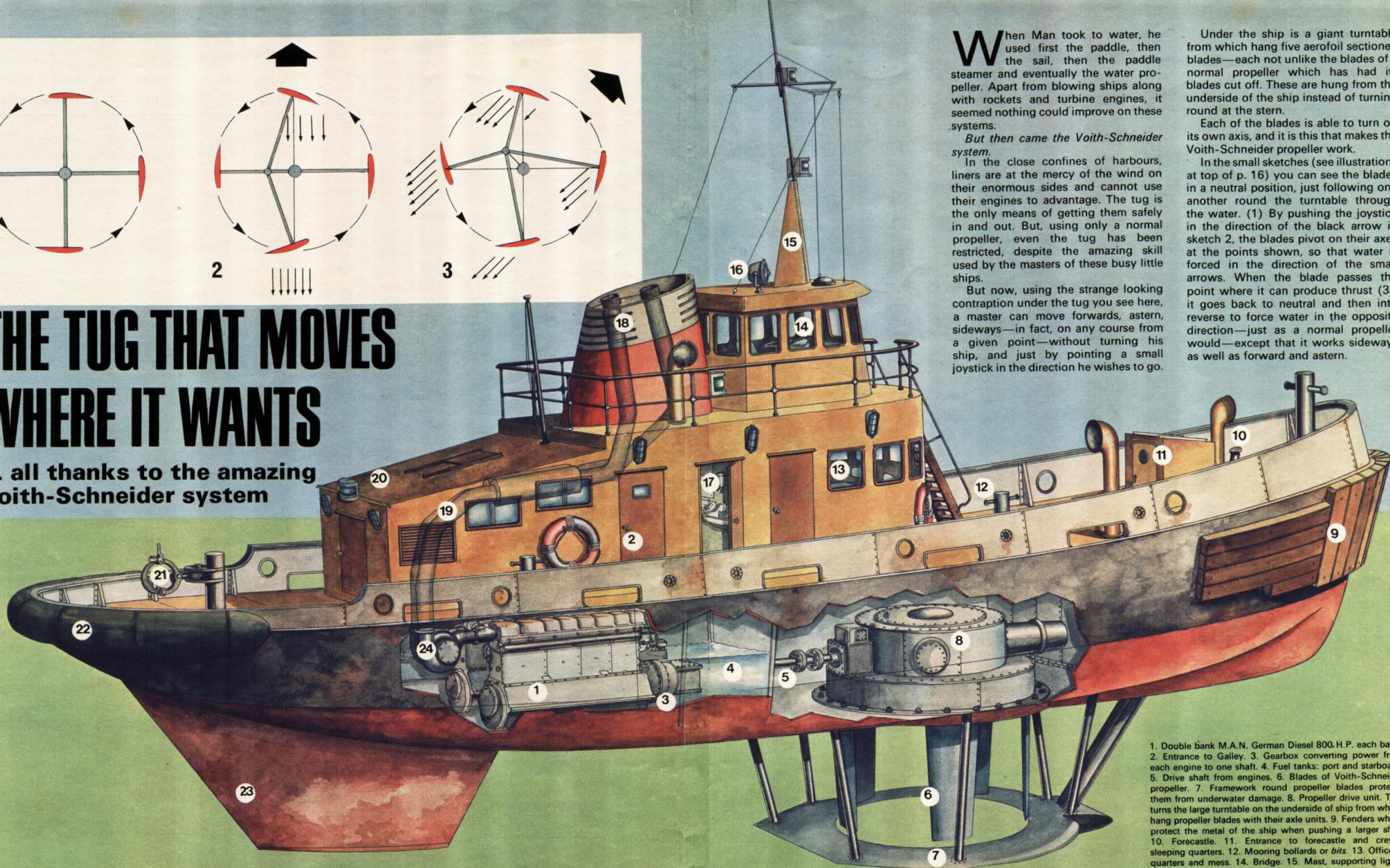
THIS WEEK'S STRANGE STORY: PAGE 30





THE TUG THAT MOVES WHERE IT WANTS

... all thanks to the amazing Voith-Schneider system



When Man took to water, he used first the paddle, then the sail, then the paddle steamer and eventually the water propeller. Apart from blowing ships along with rockets and turbine engines, it seemed nothing could improve on these systems.

But then came the Voith-Schneider system.

In the close confines of harbours, liners are at the mercy of the wind on their enormous sides and cannot use their engines to advantage. The tug is the only means of getting them safely in and out. But, using only a normal propeller, even the tug has been restricted, despite the amazing skill used by the masters of these busy little ships.

But now, using the strange looking contraption under the tug you see here, a master can move forwards, astern, sideways—in fact, on any course from a given point—without turning his ship, and just by pointing a small joystick in the direction he wishes to go.

Under the ship is a giant turntable from which hang five aerofoil sectioned blades—each not unlike the blades of a normal propeller which has had its blades cut off. These are hung from the underside of the ship instead of turning round at the stern.

Each of the blades is able to turn on its own axis, and it is this that makes the Voith-Schneider propeller work.

In the small sketches (see illustrations at top of p. 16) you can see the blades in a neutral position, just following one another round the turntable through the water. (1) By pushing the joystick in the direction of the black arrow in sketch 2, the blades pivot on their axes at the points shown, so that water is forced in the direction of the small arrows. When the blade passes the point where it can produce thrust (3), it goes back to neutral and then into reverse to force water in the opposite direction—just as a normal propeller would—except that it works sideways as well as forward and astern.

1. Double bank M.A.N. German Diesel 800.H.P. each bank.
2. Entrance to Galley. 3. Gearbox converting power from each engine to one shaft. 4. Fuel tanks: port and starboard.
5. Drive shaft from engines. 6. Blades of Voith-Schneider propeller. 7. Framework round propeller blades protects them from underwater damage. 8. Propeller drive unit. This turns the large turntable on the underside of ship from which hang propeller blades with their axle units. 9. Fenders which protect the metal of the ship when pushing a larger ship.
10. Forecastle. 11. Entrance to fore-castle and crew's sleeping quarters. 12. Mooring bollards or bits. 13. Officers' quarters and mess. 14. Bridge. 15. Mast, supporting lights and aerials. 16. Spotlight. 17. Crew's washplace. 18. Funnel.
19. Engine exhaust uptake pipes. 20. Engine room auxiliary equipment space. 21. Towing hook. 22. Rubbing fender. 23. Skeg-fixed rudder acts as a weather-vane and keeps the ship's head to direction. 24. Engine exhaust uptake fans.

STORY OF THE CINEMA

PART 7

CINERAMA

Fred Waller, the man who made Cinerama possible, began working on his invention as far back as the middle thirties. One of his main problems was that human eyes, used together could only take in an arc of vision of 130 degrees. His system required them to widen and take in an arc of 145 degrees to 160 degrees. He solved this by using a 90-foot-wide deeply curved screen, which also gave an impression of 3D for those who were not watching the screen from the side seats. To begin with, the Cinerama process used three cameras to obtain a single image.

Speaker systems behind screen

Sound-control

Picture-control engineer

Extra speakers for off-screen noises

PROJECTOR

PROJECTOR

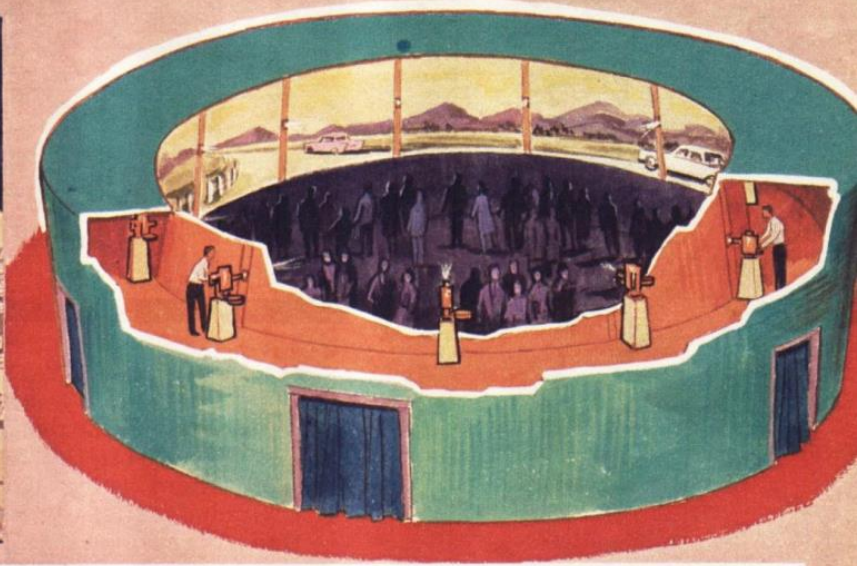
PROJECTOR

For Cinerama a special camera was developed which simultaneously took three pictures from three different angles. At the same time, six microphones picked up the sound and placed it on tape for a magnetic sound recorder. The speaker systems were arranged behind the screen to produce varying intensities of sound; and three projectors directed the films on to the curved screen. In 1963, Cinerama evolved a process that required only one camera and projector.

WIDENS YOUR EYES



As far back as 1900, there was a remarkable invention known as Cineorama, shown at the Paris Exhibition. The audience sat in the basket of a mock balloon and hand-coloured motion pictures were projected on a circular wall.



A similar principle was used much later by Walt Disney for his Circorama, which was used at Disneyland in California. In this case the audience was surrounded by a circular screen which gave them a panoramic tour of the States. A Russian version called Circlorama appeared in London in 1963.



Today, we can see films in Cinemascope, Ultra Panavision, and various other processes that give us a large screen at least twice the size of the normal screen. But what really counts is the story and how it is turned into a film. After the writer has completed his shooting script, the set designer produces design after design, and after the best of them have been accepted they are either made full-scale by studio workmen, or realistic models are made.



If the film is a period one, the costume designer's role in making the film is equally important, because the costumes must be authentic in every detail. Then the technical adviser reads the script minutely for any technical error. The cast and the director have been chosen long ago. And now production starts. On average, for every day of shooting, only one and a half minutes of film will go into the can.



TO BE CONTINUED

Exciting Stories of our Exciting World

WORLD of WONDER

EVERY MONDAY . PRICE 1/6d. (7½ New Pence) No. 32 . 31st OCTOBER 1970

Eire 1/11d (9½ New Pence) Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d

**WHY DOES A BOOMERANG
COME BACK?**

STORY: PAGE 27



Also Inside

**HOW A
RECORD
IS MADE**

The fascinating story
behind the scenes.
See page 18.

Australia's Great Barrier Reef is a seriously threatened

STARFISH ARE DESTROYING

Green Island, a lush tropical paradise fringed with palm trees, only 18 miles from the Queensland coast, owes its very existence to a tiny sea animal one-eighth of an inch long.

For Green Island, discovered by Captain Cook exactly 200 years ago, is a true coral island. It has been built up over the centuries from the limestone skeletons of millions of small creatures called coral polyps.

The island is only one of many that make up the fantastic Great Barrier Reef, the largest coral reef in the world, one of Australia's great natural wonders. Over 1,250 miles long and 80,000 square miles in area, the Reef is almost as large as the whole of Great Britain.

Captain Cook came across the Reef by accident when he ran aground on it in 1770. And his ship was only one of many. The jagged coral has been a graveyard for numerous ships, for it is mostly under water, except at low tide.

Throughout its length, the Reef is studded with small islands like Green Island. Called 'cays' these have been built up in the same way as the reef itself.

Sand, thrown up by the tides, has collected in crevices and on flattened areas of the coral. Seeds blown by the wind, carried by birds, or simply floating from the mainland, have taken root, and today, many cays are thick with mangroves, casuarina trees, pisonias, pandanus and coconut palms.

The Reef throbs with life. Below the water the coral animals multiply. Jelly-like in structure, these polyps, as they are called, are tiny sea-anemones.

Polyps can absorb lime from the sea-water, and by converting this into limestone they produce a hard, irregular disc, by which

they attach themselves to a convenient rock. This way they ensure that they are not swept away by the tides.

Hundreds of these polyps anchor themselves together in colonies, so that the limestone discs become fused together. This results in a huge limestone mass, which is punctured all over with hundreds of small holes, in which the polyps live.

Within this limestone mass, too, the polyps make a network of tiny canals, through which they can communicate with each other. The polyps, miniature flower-like animals, live so close to each other in their holes that when they peep out, the coral seems covered in a skin of bright colour.

During the day, the polyps usually withdraw into their holes, coming out at night to feed upon plankton. When the polyps have produced eggs, the new animals attach themselves to the mass, and more and more coral is added to the whole. Gradually, the layer beneath becomes dead, and in this way the formation is built up.

Wondrous Sea Creatures

The Reef itself is the home of countless numbers of multi-coloured fish, which teem in the blue waters. Wondrous sea creatures hide in those coral forests—shellfish of fantastic shape, sea anemones like undersea flower-beds, sea cucumbers, sea urchins, hermit crabs and spiny oysters.

In the far northern part of the Reef lives the world's greatest shell-fish, the giant clam, which grows to huge proportions, often weighing several hundredweights. Huge green turtles swim out to the islands to lay their eggs in the soft white coral sand.

wonderland of nature...

'PARADISE'

At holiday times, the Reef is dotted with small boats as tourists from all over Australia descend upon the islands, clambering over the reefs, collecting the beautiful shells. But they also brave the terrors of stinging jelly-fish like the sea-wasps, Portuguese men-o'-war, and the deadly venomous stone-fish, whose spines can penetrate a man's shoe.

The coral polyps are sensitive creatures, and can be killed easily. Contact with fresh water or mud will destroy them, and they also have one natural enemy which has become increasingly dangerous.

This is the formidable 'crown of thorns' starfish, once rare, but now common in most coral formations in the Pacific. The starfish feeds on the polyps by attaching itself to the reef, and sucking up the jelly-like coral animals until the limestone is bare of life. With the polyps gone, the limestone skeleton becomes white and dead.

Soon, algae grow upon the limestone, and this prevents new coral animals from attaching themselves to it. The dead limestone becomes hard and brittle, and is soon broken up by the waves, which carry it away. Some Pacific islands have lost nearly all their coral in this way, and whole islands of coral have been destroyed.

Because the coral is also the home of millions of fish and other sea creatures, these too, disappear when the coral dies, and native peoples, who rely upon the fish population for food, can starve.

In Australia and elsewhere in the Pacific, active measures are being taken to find ways of killing off the starfish. One way is by using skin-divers, who destroy the animals with a special underwater gun. Another way is to encourage the growth of the giant triton, the natural enemy of the starfish, which devours it on sight.

Unless these efforts are successful the Great Barrier Reef, one of nature's greatest and most beautiful 'paradises', will be in severe danger of becoming the Great Barren Reef.



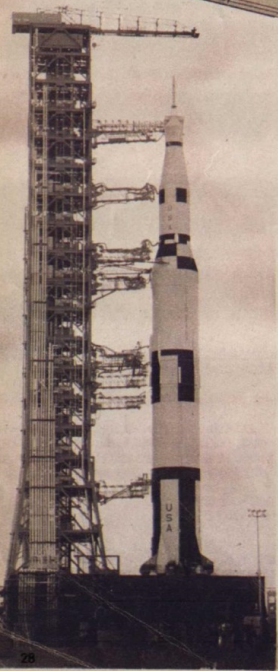
Polyps, the tiny flower-like creatures of the Great Barrier Reef, live so close to each other that when they emerge from their holes, the coral seems covered in a skin of bright colour.



Whole islands of coral have been destroyed by the 'crown of thorns' starfish. Skin divers are now using special underwater guns containing formaldehyde to kill off the starfish.



SLOWEST VEHICLE IN THE WORLD



In these days of high speeds on the roads this tractor could be a real traffic-jammer. It travels at one mile an hour.

But this machine will never be used on any public roads. Costing £4,000,000, it is the giant mobile launch platform used to help the 365-foot Saturn rockets on their way to the Moon.

In the photograph on the left is the vehicle with a Saturn rocket in place slowly rolling out of the huge building where it was assembled on the mobile launcher.

Inside the building, the rocket is assembled, all the complicated systems are put in, everything is checked a hundred—yes a hundred—times. The rocket is fuelled and made within one per cent of being ready. And this is where the mobile launcher comes in.

It is powered by electric motors through giant gearboxes which give a top speed of one m.p.h. Electricity is provided from within the vehicle itself by generators driven by a pair of 5,500 h.p. diesel engines. Hydraulic rams turn the tracks during the three-mile, three-hour journey to the launch site.

On top of the crawler part of the transporter is a box, 25 feet high, 160 feet long and 135 feet wide. At each corner is a hydraulic jack which, when in position, will lift the box, rocket and tower clear of the crawler. The crawler is then driven clear of the blast from the rocket.

When the rocket has been fired and the

charred box cooled, the crawler is driven back under the box, the hydraulic jacks are lowered and the box goes back for repainting and another rocket.

Why cannot the rocket be assembled on the spot from which it is fired, you ask. A modern rocket system like the Saturn V must be built in almost clinical conditions with humidity and temperature controlled very carefully.

One tiny droplet of moisture in the wrong place, say in an electrical junction

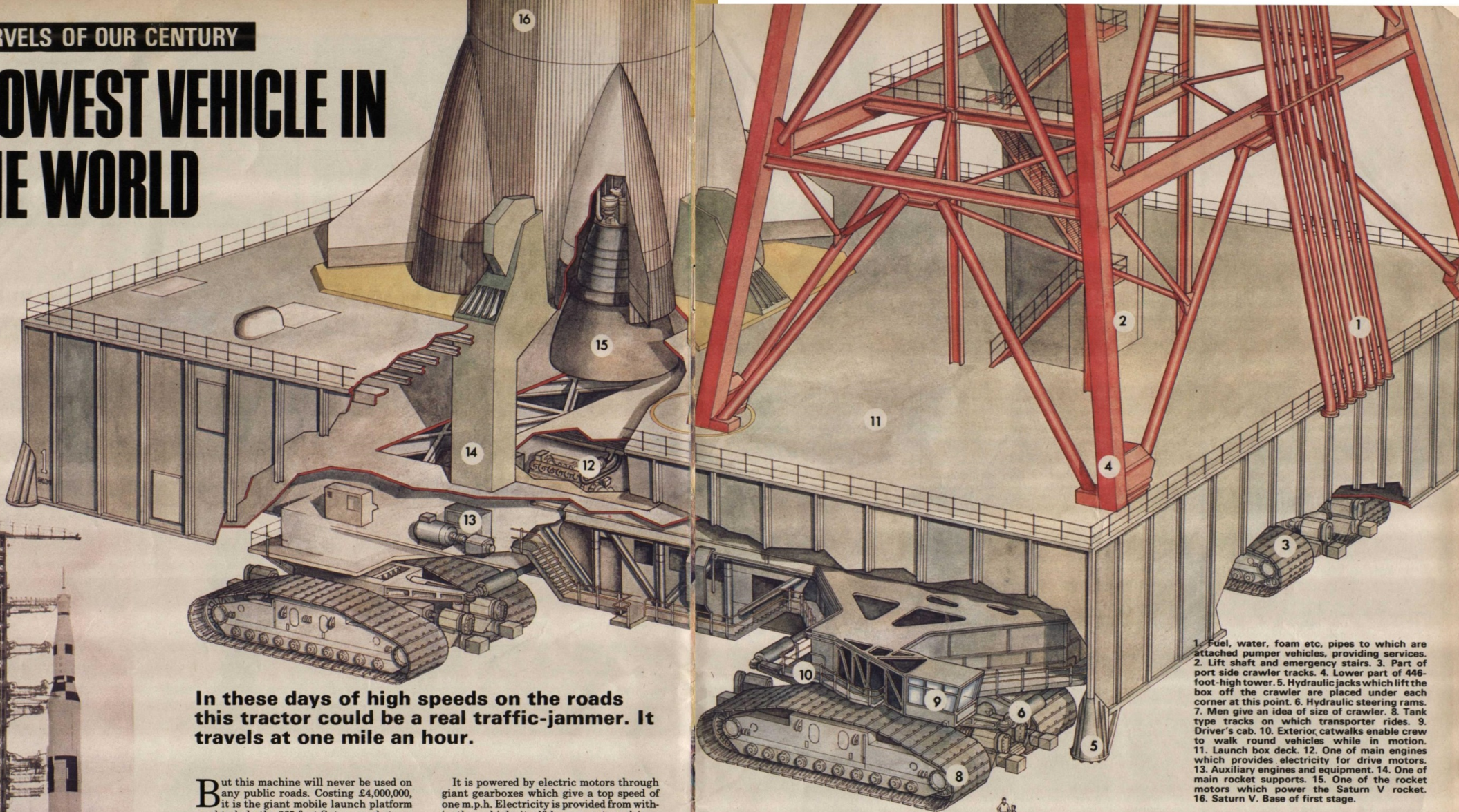
box, could mean a short circuit out in space causing a disaster. Who knows, just this might have set up the reaction which caused *Apollo 13* to become such a near miss disaster.

On top of the launch "box" is a tower with 18 floors, enabling crew men and specialists to attend to the hundreds of systems needing constant checking and attention. The tower provides all the services that could be required during the last four hours before blast off. Lifts, water,

electricity, power tools, fire fighting equipment of every sort, cold air, hot air, "top up" fuels—in fact everything the engineers could want to get the rocket safely away.

The tower is topped by a crane which is used to lift the sections of the giant rocket into place. On top of the crane is a flashing red light—446 feet above the ground.

By the way, when the transporter is returning from the launch site empty it really gets speed up and has been known to dash along at two m.p.h.



1. Fuel, water, foam etc. pipes to which are attached pumper vehicles, providing services.
2. Lift shaft and emergency stairs.
3. Part of port side crawler tracks.
4. Lower part of 446-foot-high tower.
5. Hydraulic jacks which lift the box off the crawler are placed under each corner at this point.
6. Hydraulic steering rams.
7. Men give an idea of size of crawler.
8. Tank type tracks on which transporter rides.
9. Driver's cab.
10. Exterior catwalks enable crew to walk round vehicles while in motion.
11. Launch box deck.
12. One of main engines which provides electricity for drive motors.
13. Auxiliary engines and equipment.
14. One of main rocket supports.
15. One of the rocket motors which power the Saturn V rocket.
16. Saturn V. Base of first stage.

Exciting Stories of our Exciting World

WORLD of WONDER

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Europe 1/11d (9½ New Pence) Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/8d

HEADLINE CITIES

A sparkling new series that investigates the year and events that made a city famous.

See Page 7 for Paris at the time of the French Revolution.



Though neither of the Poles sounds like a home from home the unexploited mineral wealth is so great that nothing will stop men from going there to get it out. It will be a century or more before men find means of getting at the ore-rich rock from the centre of the land mass, for the continent has an average ice thickness of 9,000 feet. But in places where rock is exposed mining will be less of a problem.

In some islands off the coast, semi-precious stones have been found almost too heavy for a man to lift, and the world's most southerly known coalmine is just 200 miles from the Pole itself.

The world's need for oil is the biggest single attraction for men to make their homes in the Arctic. Alaskan oil is so far the only Polar fuel worth extracting, but the demand for world oil is expected to double by 1980 at least.

Apart from prospectors and geologists, the Antarctic in particular is likely to become a tourist spot. Those who like unusual holidays, birdwatchers interested in penguins and winter sports enthusiasts are already keen to go there.

Biggest Desert

In fact, the first tour of Antarctica is history. It was organised by the Argentine government 12 years ago. The Chilean government followed suit soon after. Five years ago even the French government was planning to run regular air trips to McMurdo in summer. The idea never caught on, not because there were no takers—there were plenty—but simply because there was just no hotel accommodation in Antarctica itself. When those hotels are built, McMurdo will actually begin to look like a city.

The days when the Olympic Winter Sports are held in the "white hell" that killed Captain Scott are not too far off even now. Antarctic snow is perfect for sports. The air is completely dry and so is the snow, just what the skier wants.

In fact, the air is so dry that Antarctica is really the biggest desert in the world. It has

been estimated that the amount of water that falls on it in a year is no more than two inches. Blizzards are actually fallen snow driven along by the wind. The explorer is often buffeted by snow centuries old.

When there is a permanent population the cities housing it will have to withstand everything the savage weather can throw at them. In 30 years' time the first thing that will strike the tourist when he sees a Polar city will be that houses are made of plastic, probably highly coloured to suit the owner's taste. Plastic is proving itself a far better insulator than wood ever could be.

Entering his hotel he will have to pass through three doors. If he has just arrived he will be told to take off his outer coat—immediately. Taking it off in the freezing outer hall will be essential to prevent the biggest curse of the Polarman—moisture. Moisture can kill. In the outer hall snow

will not thaw, so he will be able to wear his coat safely outside where otherwise the permanent sub-zero cold would be transmitted direct to the skin through the wet fabric.

Polar houses will have another novel feature not found anywhere else. A door in the roof. It won't be there to help an overweight Santa Claus at Christmas but as a means of escape if the house is covered by drifts.

If the city is built above ground all the houses could be sitting on skis. Once a year a nuclear-powered tractor will call round and heave the house up over the lip of the year's fall to the new level. Hotels will get the same treatment. They will be built in prefabricated sections which can be split easily and moved independently.

At the North Pole there is an average snow fall of 30 feet a year so cities will

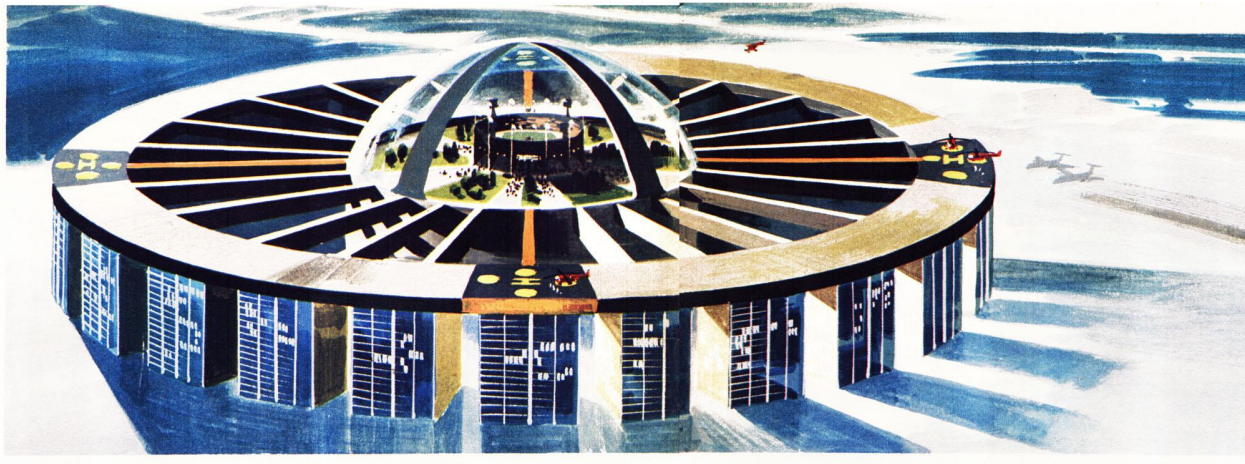
probably follow the pattern of today's American base, Camp Century in Greenland. North Polarman won't be too concerned about the weight of snow on top but they'll be permanently worried about "creep". Ice has a tendency to flow like water in very slow motion and the result is that the walls of ice move in on the camp at the rate of two feet a year.

Every six days at Camp Century men scrape 40 tons of ice out of the tunnels in which the base is housed.

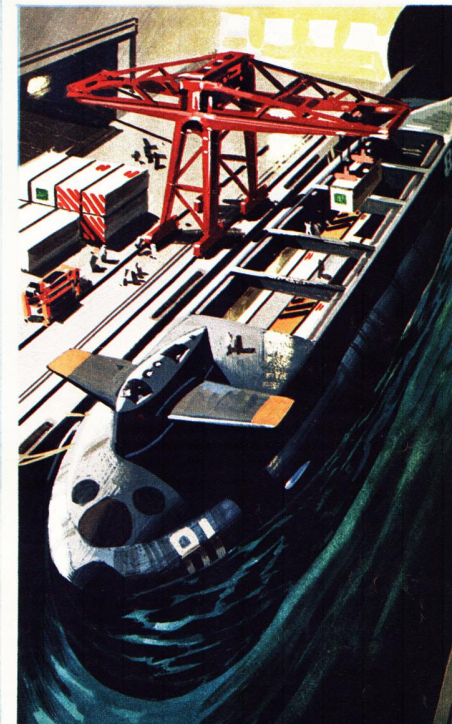
Another idea which has been put forward is the "covered city", a whole complex of buildings standing in a circle. Corridor

Here is one idea for an Arctic city—a huge circle of buildings connected by corridor street, with a huge plastic dome in the centre. Transport between this city and others might be in nuclear-powered trains on sledges—or in nuclear submarines travelling under the ice and surfacing at specially-designed 'harbours'.

Another idea would be to have plastic houses which could be moved to prevent them slowly being buried in the snow.



Could this be the Arctic city of the future?





The Aurora Borealis, or Northern Lights, will certainly provide a spectacular background for skiers—even if these electronic displays play strange tricks with radio and TV reception.



A snow plough whirls snow into the air to cover the inflatable shelter of the surveyors searching for the oil and mineral wealth that lies beneath the surface.

streets would connect the buildings and also run to the city centre—a vast dome with an inner and outer shell to provide insulation.

Inside the dome the climate would be controlled, and there would be gardens, sports arenas, football grounds, meeting places and so on.

It all sounds like a dream, but in a hundred years' time...

In both Poles most cities will be in the middle of mountain ranges—unlike every other major city on Earth. On the ranges geologists will find bare rock to work on.

Ice Like Concrete

In fairer weather both mountains and plains will be criss-crossed by men in search of oil and minerals in enormous caterpillar tracked vehicles. One essential item of equipment will be a miniature snow plough that will suck in snow and mill it in rotary blades. It will be needed to cover the inflatable shelter the surveyors will sleep in. Because the temperature rarely rises above freezing, ground-up snow freezes as solid as concrete in a few hours.

The miniature pump will suck up snow, grind it into sugar-like grains and neatly cover the shelter, which will look little different from igloos.

Clothing will be very different and weigh a lot less than the 40 lb worn by the Polar heroes we have been reading about in the past few months in *WORLD of WONDER*. Today's scientists carry no more than 15 lb, made up of lightweight material designed to trap warm air against them in layers. But Polar men of the future will wear even lighter clothes, for they will take a leaf from the astronauts' notebook. They'll have plastic one-piece suits.

The space suits of the first men on the Moon were encased in two thin films of plastic. The outer one was air tight and the inner one was moisture proof. It is these two films that will protect the Polar men of tomorrow.

Another solution, already being worked



on by Russia and America, is a Polar suit that will be equipped with two battery-driven fans to circulate air and dry the skin.

The big problem with life in the Arctic, apart from cold, is travel. At the moment petrol is worth twice its weight in gold but it is bulky and expensive. Forty years from now it won't be half so precious. Goods, men and equipment will be shifted across the white desert in long, snakelike trains powered by a small nuclear generator. On closer inspection the tourist would see it was really nothing like a train at all. The carriages would run on sledges and the "engine" would be a caterpillar tractor.

Underground Railway

Plans are also well under way to construct what will become the world's longest underground railway, linking Camp Century to the coast 138 miles away.

One thing the Polar dwellers will have to do without, unless there are some unexpected advances in telecommunications, is television.

The reason is the Aurora Borealis or Northern Lights (in the south, Aurora Australis or Southern Lights). This is a spectacular display of colour produced in the atmosphere as a result of the Earth's magnetic field being temporarily affected by hydrogen atoms given off by the Sun.

The lights are beautiful to look at but deadly to wireless waves.

The electronic effects are so unpredictable that experimental television receivers in the South Pole have been able to pick up London telecasts for a brief while. The Lights have then effectively blocked wireless messages between sets 20 miles apart.

The Great Magazine For All Boys and Girls
WORLD of WONDER

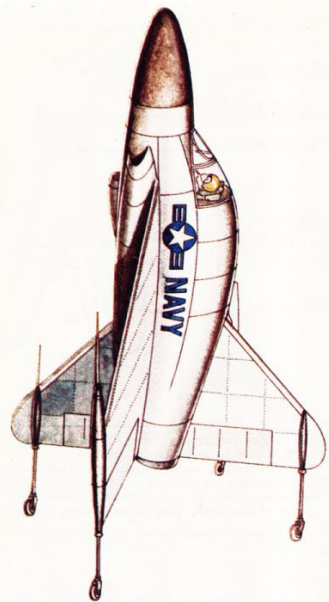
EVERY MONDAY . PRICE 1/6d. (7½ New Pence) No. 39 . 19th DECEMBER 1970

Eire 1/11d (9½ New Pence) Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d

*LEGENDS FROM
MANY LANDS*

A sad but inspiring story
from Japan is on Page 3.





Both the Americans and the French were very interested in the idea and produced vertical take off and landing machines in the early fifties. The nearest to the wartime German Triebflugel (on the far right) was the Ryan fighter which, although using a propeller to lift off the ground and drive it through the air, used its cross-like wings for lift as well as providing a base to land on.

Fin and Rudder

Prop-jet engines drive the shafts to the propellers

Tailplane

Main retractable undercarriage

Propeller

This cutaway is of the Bell X22A. It uses its barrel wings to take off. Then the wings are gradually tilted until they are facing forward instead of upward. They are the wings with propellers inside them. To stop, the wings are gradually tilted to the upwards position again. By gradually reducing power the machine settles back on to the ground.

Barrel wings

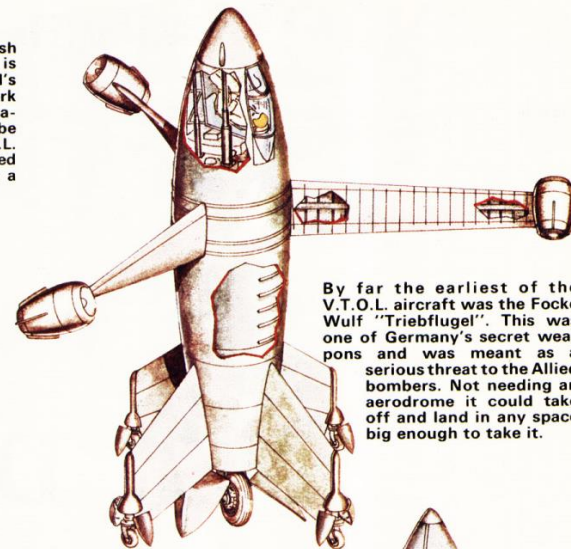
Propeller

Shafts run through the fuselage to forward gearboxes and then to forward propellers

Cockpit

A true, man-made, flying saucer that everyone could see. This was the Canadian Avrocar of 1961. To take off, it used a cushion of air caused by air at high speed off the edge of the circular wing. While riding on this cushion of air, the Avrocar would be jetted forward until its shape became an efficient aerofoil and the machine would take off. Canada spent 7½ million dollars on this project before it was abandoned.

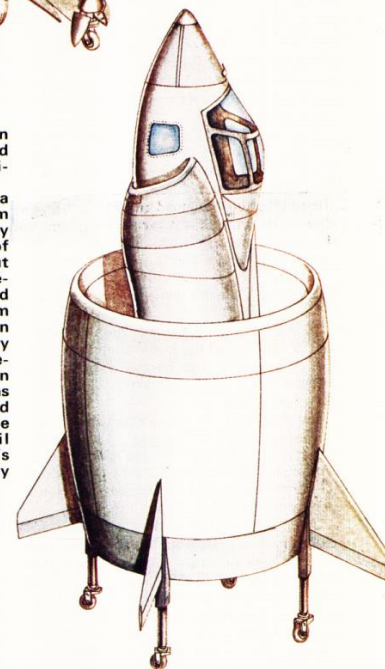
As a fighter project the British Harrier V.T.O.L. machine is without a doubt the world's best. In the London-New York race it caught everyone's imagination and shows itself to be almost the last word in V.T.O.L. planes. America has just ordered 18 Harriers from Britain at a cost of £130,000,000.



By far the earliest of the V.T.O.L. aircraft was the Focke Wulf "Triebflugel". This was one of Germany's secret weapons and was meant as a serious threat to the Allied bombers. Not needing an aerodrome it could take off and land in any space big enough to take it.

This is the French version of a plane that would land and take off vertically—the coleopter.

This "barrel round a fuselage" was, apart from anything else, a good way of saving space! Instead of having wings sticking out on either side, the designers wrapped it round like a barrel with bottom and top knocked out. When forced through the air by the jet engine in the fuselage, which was kept in position by slender fins between its outer skin and the inner skin of the "barrel", the aerofoil section of the barrel's surface was just like any part of any wing.



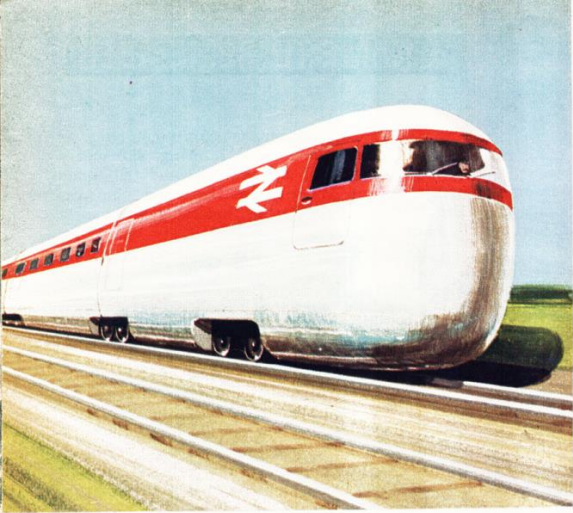
STRAIGHT UP AND DOWN

WORLD of WONDER

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Christmas Present For the Priest in Dawson City. SEE PAGE 23



There is still plenty of life in the old rails and they will be with us for a long time to come. Above is our artist's idea of what the British Railway's 'Advanced Passenger Train' will look like. It is expected to start its trials very soon and eventually it should be able to do 200 m.p.h. It will be driven by gas turbines and its first maximum speed will be 120 m.p.h. Once the railways are used to running trains at this speed, the speed will be gradually increased.

Below: What Britain's new hovertrain will probably look like. An experimental track is to be built which will be a monorail with the car floating on a cushion of air. The train will be electric, driven by a "linear motor", which means that the track has a coil of wire all the way along it like a bar in an electric fire. Special coils inside the car will react to the electricity of the coils on the track and this will make the car travel at speeds between 200 and 300 m.p.h.

CONCLUDING TALKING OF TRAINS

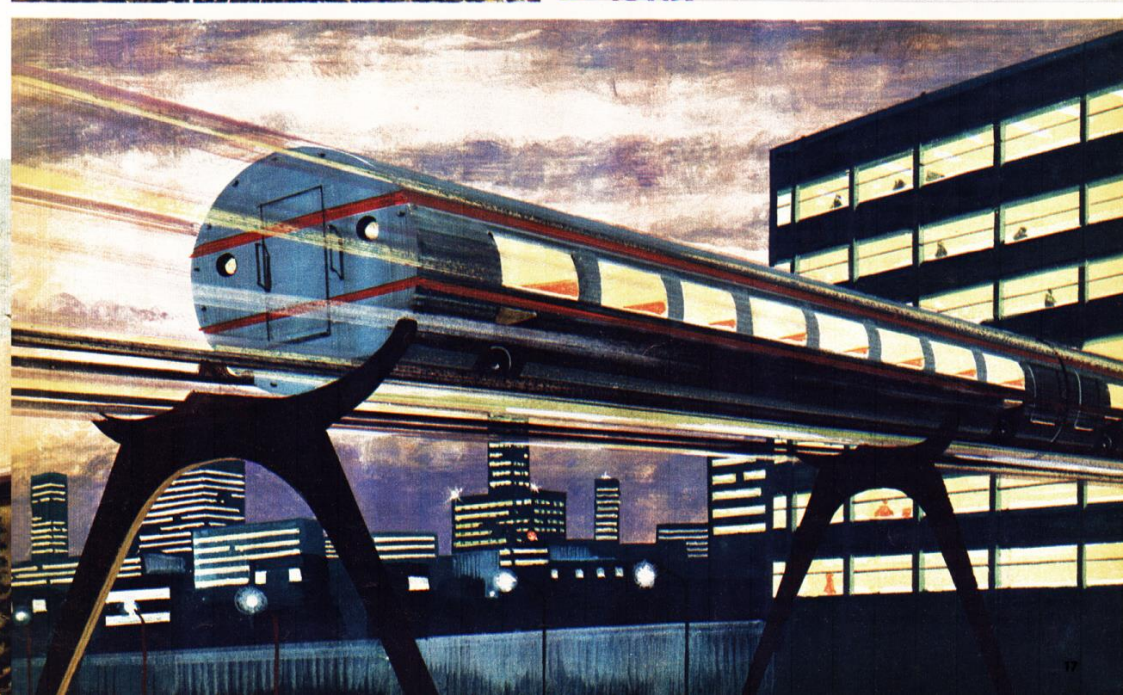
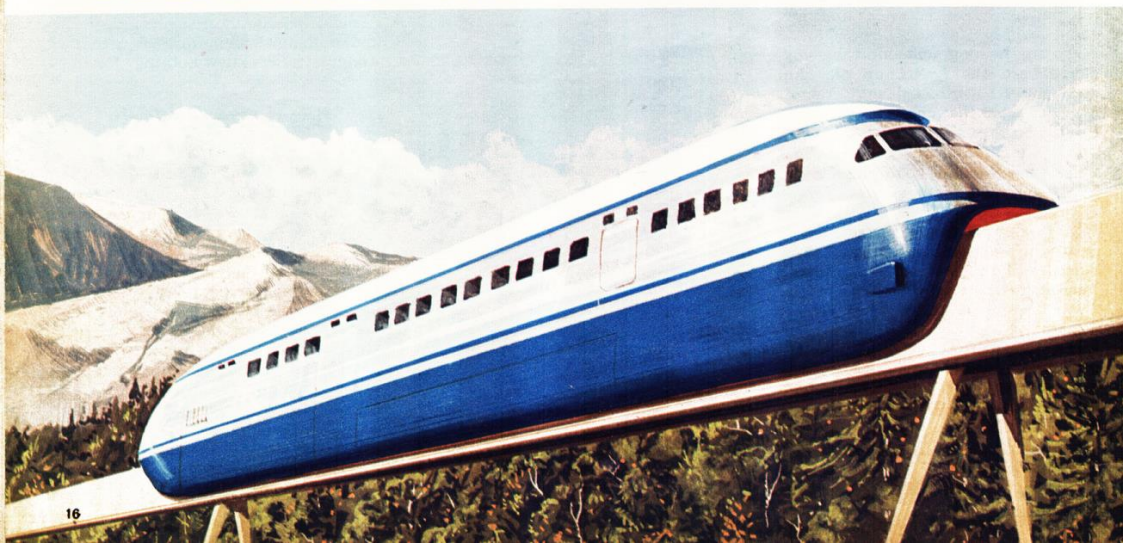
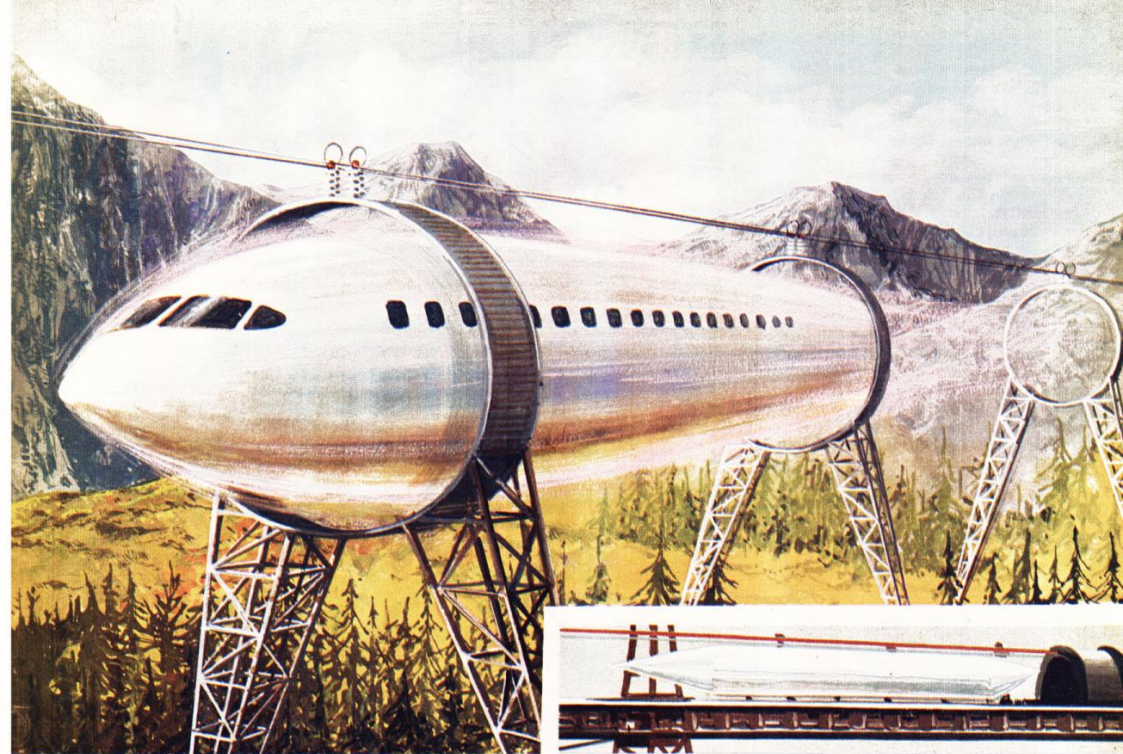
Inventors have by no means finished with trains, even if some of them intend to discard rails!

The "railway" on the right was suggested by a French inventor named Bachelet before the First World War. It was based on a discovery by an American scientist that aluminium and copper are momentarily driven off by an electro-magnet when the electricity is switched on and are attracted to it when the electricity is switched off!

Bachelet built a model railway (shown inset) using this method, which worked extremely well. The inventor foresaw that speeds of over 300 m.p.h. would be possible. At this speed, he believed, the scientifically-designed cars could shoot through a series of circular electro-magnets and that rails would only be necessary at stations.

The train in the lower picture on the right, based on an American idea, is propelled through an air-tight tube. This train would not need a motor because the air would be sucked out of the tube ahead of the train and compressed air fed in behind it. The idea is not entirely new. The General Post Office ran a tube like this in London, in 1863. It was very successful for a time, but unfortunately the pipe began to leak and could not be mended, so the line had to be abandoned.

Today it would be possible to make a satisfactory tube which could be carried under or over the ground and which could be transparent to let in daylight. The train would be automatic and speeds of 200-300 m.p.h. are visualised.



TRAINS OF THE FUTURE

WORLD of WONDER

Incorporating TREASURE

EVERY MONDAY . PRICE 1/6d. (7½ New Pence) No. 45 . 30th JANUARY 1971

Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d



Shakespeare wrote
The Merchant of
Venice... or did he?

See Page 14

WORLD'S BIGGEST TRACTOR

MACHINES AT WORK



The giant triple rippers make light work of tearing out a ditch eleven feet wide and four feet deep. A special single pronged ripper can also be used to dig to a depth of seven feet.



Designed in America by the Allis-Chalmers Company, this HD-41 crawler tractor is the biggest in the world.

Powered by a 524-horse-power diesel engine specially designed to operate at up to 12,000 feet without loss of power, the HD-41 weighs over 50 tons, is 20 feet long, ten feet high and eleven feet wide.

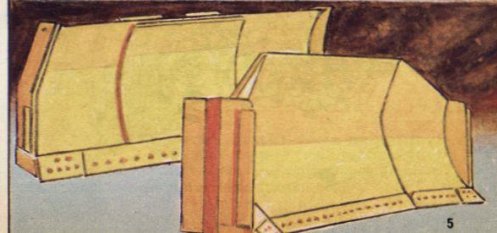
It can rip its way through rock, tear out ditches, level areas for land reclamation or building sites, and be used in open cast mining where the coal or minerals are close to the surface.

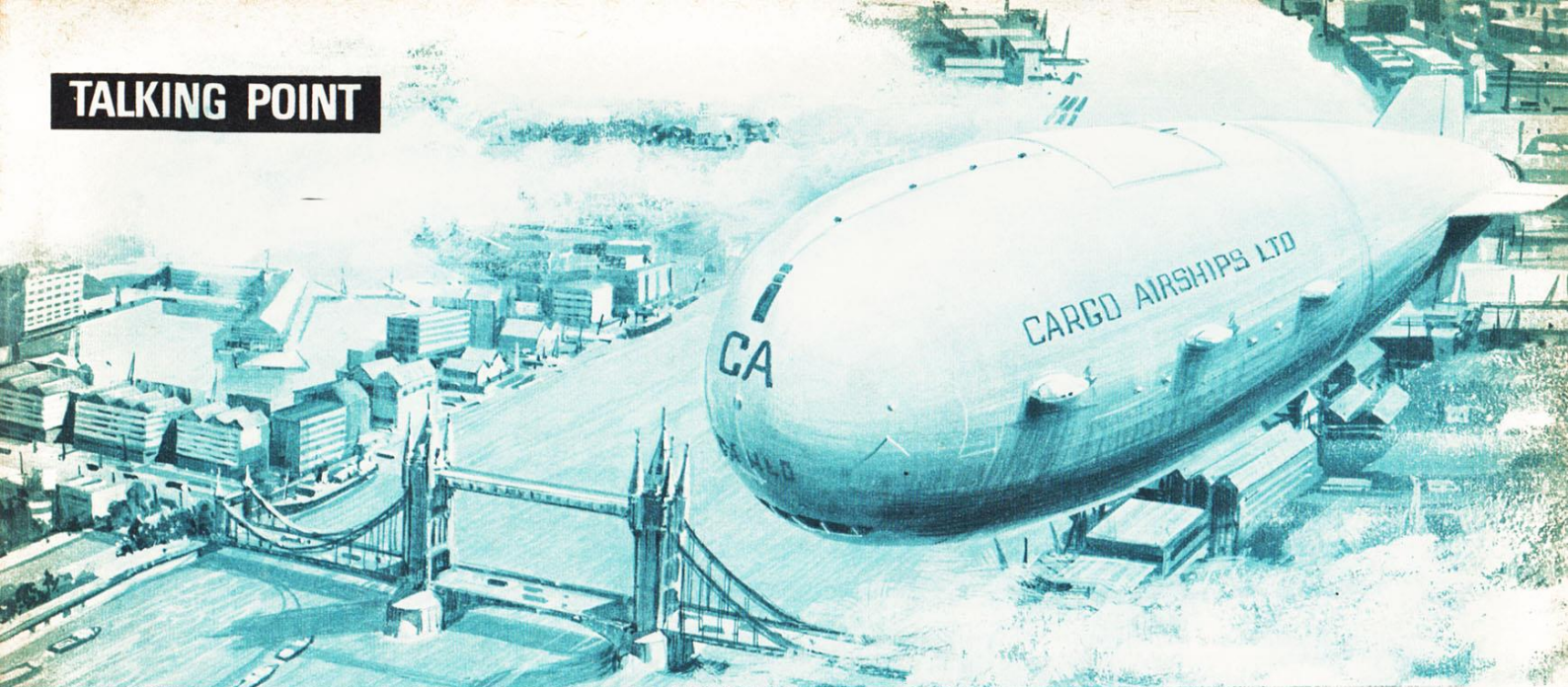
One of its greatest advantages is in rocky areas where flattening and levelling previously had to be done by blasting with explosives. In one continuous operation the giant can rip through rock to a depth of nearly four feet, loosening an area nearly as wide as itself and then dozing the material to one side, leaving a flat, level path.

KEY

- 1 Front radiator.
- 2 Dozer blades.
- 3 Hydraulic system.
- 4 Largest diesel engine in any crawler tractor—524 horse-power.
- 5 Pusher beam for bulldozing blades.
- 6 Caterpillar tracks.
- 7 Track roller.
- 8 Drive sprocket.
- 9 Giant ripping attachments.
- 10 Rear radiator.
- 11 Engine air intake.
- 12 Engine exhaust chimneys.
- 13 Floodlights.

For filling in ditches, gullies and trenches or levelling vast areas, the tractor has three types of dozer blades depending on the type of work to be carried out. Here are two of them.





WILL AIRSHIPS RISE AGAIN?

The answer is yes—if a new British firm has its way—for with better materials and increased knowledge these giants of the sky could make a comeback!

The huge silver airship flies quietly and sedately above London. Aboard, there are more than 500 tons of cargo. Its destination: New York.

It is a graceful and pleasing sight, in direct contrast with the noise and smell of modern intercontinental jetliners.

A scene from the 1930s? A memory of the days of the *Graf Zeppelin*, the *Hindenburg* and the ill-fated R.101 (see *WORLD of WONDER* No. 21)?

Not at all... for the airship looks as if it may be making a comeback!

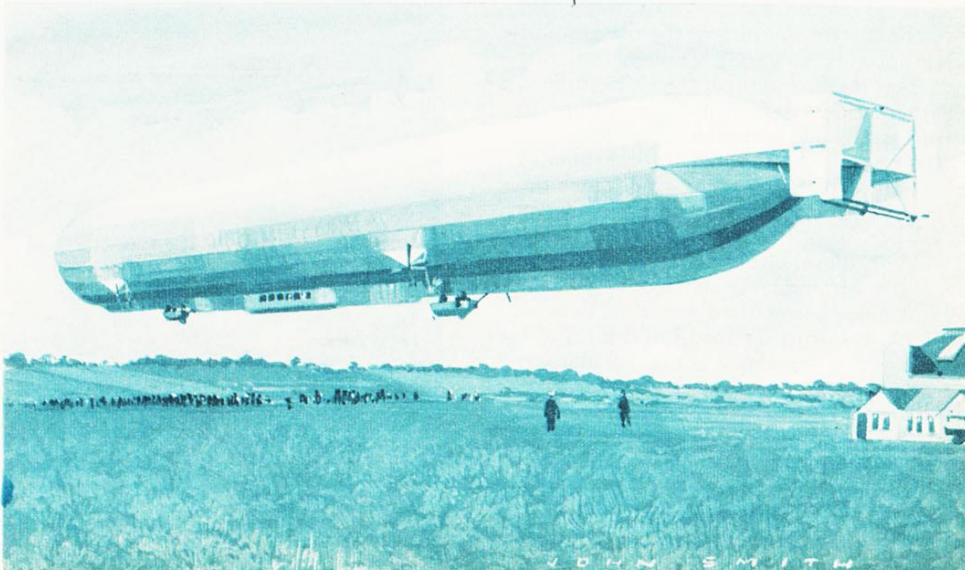
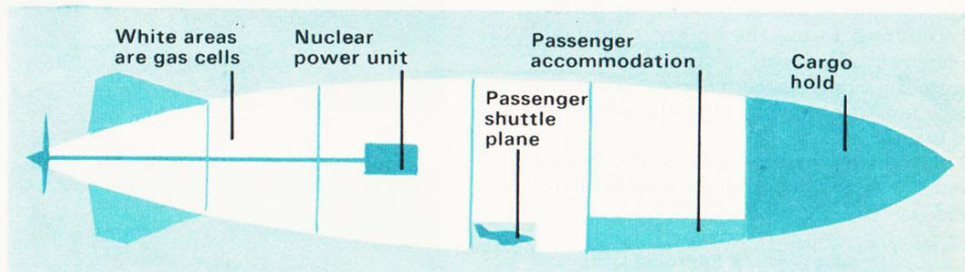
This is no idle speculation, but a new and logical step.

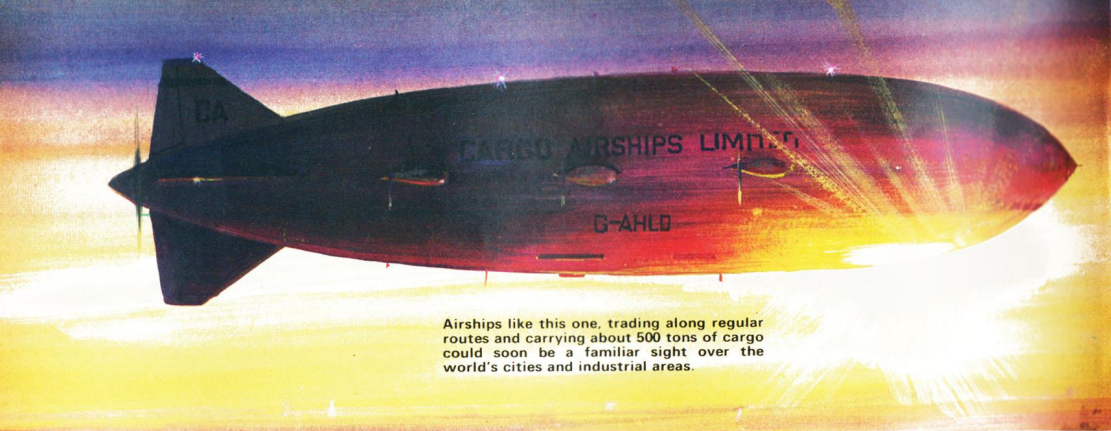
It may seem that to "go back" to the use of airships is a backward step, rather like trying to dream up a way in which a weed-infested canal could be restored to its former importance.

But the fact is that airships built in the early part of this century were *ahead* of their time!

The reason they were not a complete worldwide success was because our known science and technology at that time were inadequate to deal with the challenge of a

A nuclear power unit is included in this German proposal for a passenger-carrying airship. A light shuttle plane would ferry passengers to and from the ground. Also shown is one of Germany's earlier airships, designed by Count Zeppelin and used for carrying passengers as far back as 1911.





Airships like this one, trading along regular routes and carrying about 500 tons of cargo could soon be a familiar sight over the world's cities and industrial areas.



The airship's own helicopter (right), operating from a launch pad on top of the ship, could be used to ferry the containers of goods back and forth from the ship at stops all along the trading route.

machine as highly advanced as an airship. It is now being realised by cargo firms that our science has expanded to such a degree that airships are for the first time capable of performing in a way that their first builders hardly dared to dream!

There were three main reasons why the old airships were not a success, and why there were so many fatal accidents in them.

The first reason was because there are only two gases lighter than air which are available for airships: hydrogen and helium.

In the early part of this century, helium was comparatively rare, and very expensive. Though helium is *inert* (in other words, it won't explode) the early airship builders were forced to use the highly-inflammable hydrogen. This was safe enough under normal circumstances, but even the smallest accident was liable to blow the whole ship to pieces.

Nowadays, helium gas is much more widely available, and is comparatively cheap.

Effect of Winds

Secondly, the engines of the old airships were not very powerful. Though they had sufficient power to propel the ships in good weather, they were very susceptible to strong winds and turbulence.

The tragic crash of the R.101 in France in 1930 was caused by high winds, and the inability of the engines to steer the airship to safety.

Modern diesel-electric engines are compact and economical, and would provide almost more power than would be needed. To look even further into the future, it is possible that airships could be nuclear powered.

The third fault of the old airships lay in their construction.

Every rigid airship which has flown to date has been constructed on the "Zeppelin" principle. That is, that the airship was built with a massive and complicated skeleton, which was then covered by hand with fabric.



The result of this was that not only were the ships too heavy (and thus required so much more gas) but that they were inherently fragile. Though engineered to be strong enough to contain gases, they were not suitable for lifting heavy weights or for surviving rough weather.

Modern designers have much more experience with correct stressing (as, for instance, in the building of bridges) and in any case our modern knowledge of high-strength artificial substances (plastics, glass fibre, carbon fibres, and so forth) saves the necessity of having to build a metal skeleton.

In fact, the proposed design of the new airships uses what is known as a *monocoque* hull. That is, one that can be manufactured in several large pieces, and which when joined together will make a hull which is not only immensely strong but very light.

The new airship would look something like the plan shown below. From the scale drawing you can see it would be much larger than the pre-war *Hindenburg* airship and would dwarf one of the new Jumbo jets.

Cargo Airships Ltd., the British firm which is currently developing the idea, have plans for an airship 1,150 feet long (five times the length of a Jumbo jet) which could carry 500 tons of cargo at a speed of 100 miles an hour.

But . . . why airships? you might ask. Surely we have many different kinds of transport these days?

Heavy cargo is carried by ship, lighter cargo is carried at great speed by jets, and all local deliveries can be made by road or rail. Is this not sufficient?

This is true enough at present, but it is at the future that the airship authorities are looking.

Airships will never *replace* air, sea, road or rail. But as our air-lanes, shipping-lanes and roads become more and more congested, it is becoming vital to find a new way of carrying goods.

How would an airship system work?

It is envisaged that all cargoes carried by airships would be in the "container" system

in widespread use today. That is, they are packed in large, uniform metal crates, which can be transferred easily between lorry, train, helicopter or ship. (See *WORLD OF WONDER* No. 48.)

For example, a factory in Birmingham wishing to send material to Rotterdam would pack its goods into a container, which would be taken by container-lorry to the nearest airship depot. (The larger factories might have their own depot.)

When the airship arrives, its own helicopter (which is carried on the back of the ship itself—see illustration) would fly down to the ground, pick up the container and load it onto the ship. The time this operation would take would vary, of course, depending on the number of containers to be picked up.

The airship then flies to Rotterdam, reaching there a few hours later. The container is flown down to the ground, and the goods reach their destination almost at once. The airship then moves on to its next destination, rather like a goods-train does today.

Regular Routes

Cargo Airships Ltd., have worked out a scheme which they call M.A.C.S. (Merchant Airship Cargo Satellite system).

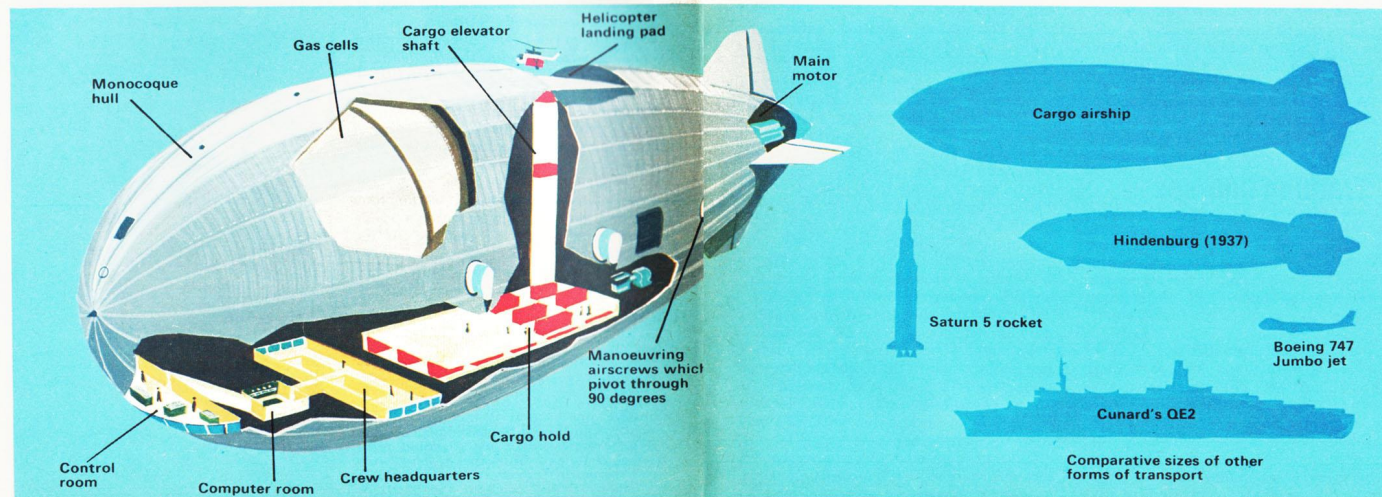
In this, there would be dozens of regular airship routes, flying every day all over Europe, and to North America, and indeed to the whole world.

Of course, there are still several problems to iron out.

One is fitting the airships into the high density of air traffic using our skies. But when *WORLD OF WONDER* spoke to Mr. Max Rynish—the inventor of the new ships—he said: "The airships will fly at between 2,000 and 5,000 feet, which is well below normal operating routes."

Another problem is the effect of air turbulence on such huge ships. But again, Mr. Rynish said: "The ships will be very stable because of their size, and the engines will be powerful enough to cope with even the most extreme storms."

So that is the prospect for airships. No longer a curious museum-piece, but an exciting possibility for the future.



SPEED ON STILTS

MARVELS OF OUR CENTURY

"Why," the inventors of the hydrofoil argued, "should we try to push a boat *through* the water when it can skim along on top?"

Key

1. Forward Hydrofoil system.
2. Hull lifted clear of the water by the hydrofoils.
3. Forward passenger saloon—40 seats.
4. Searchlight.
5. Radar scanner.
6. Wheelhouse and remote control for engines.
7. Stairs to upper saloon.
8. Passenger entrance door.
9. Upper passenger saloon—40 seats.
10. Two Maybach-Mercedes-Benz diesel engines, each of 1,100 h.p.
11. Air intake to engine room.
12. Aft passenger saloon—60 seats.
13. Fuel tanks.
14. Aft fuel tanks.
15. Steering rudders.
16. Twin propeller shafts.
17. Aft hydrofoil system.
18. Starboard propeller.



The power required to drive a ship is largely used up in overcoming the friction caused by the hull passing through the water. To overcome this disadvantage, a device known as a hydrofoil can be used to lift the entire hull clear of the water.

The principles which govern the lifting capacity of an aircraft wing can be applied to the hydrofoil working in water. As the speed of the ship increases the hull is gradually lifted clear of the water until it is supported only by hydrofoil wings attached to the hull by stilts. Looking like huge crater beetles, hydrofoils attain speeds of up to 60 knots.

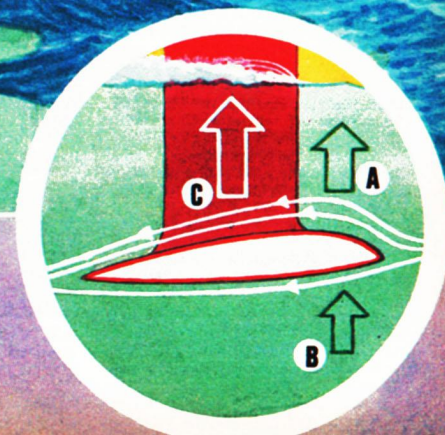
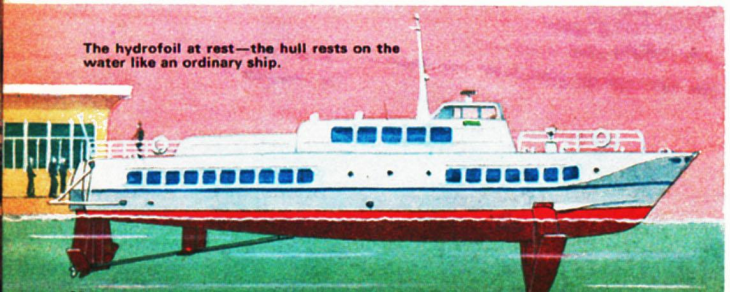
The Leopoldo Rodriques Shipyard of

Messina, Italy, was the first in the world to produce hydrofoils in quantity and the first regular seagoing service was in August 1956 between Messina, Sicily, and Reggio di Calabria on the Italian mainland. The Dutch firm Gusto of Schiedam are among many others producing hydrofoils, for today these vessels are in service in 21 countries all over the world.

A most popular type is the Rodriguez PT50 shown on this page. It is a little over 91 feet long and 20 feet wide. Displacement 63.3 tons. Cruising speed is 34 knots and the PT50 carries 140 passengers.

Hydrofoils are now being built powered by jet engines at speeds of 60 knots and carrying 400 passengers.

The hydrofoil at rest—the hull rests on the water like an ordinary ship.



Principle of the hydrofoil at speed, water acting in the same way as air on the wing of an aircraft. A. Area of low pressure. B. Area of high pressure. C. Direction of lift to the hull.

WHERE WILL WE LIVE TOMORROW?

As more and more of our precious countryside gets eaten up by houses, the problem of finding places to put people grows larger. The answer to it all could easily look like this . . .



One type of town planning—or mis-planning!

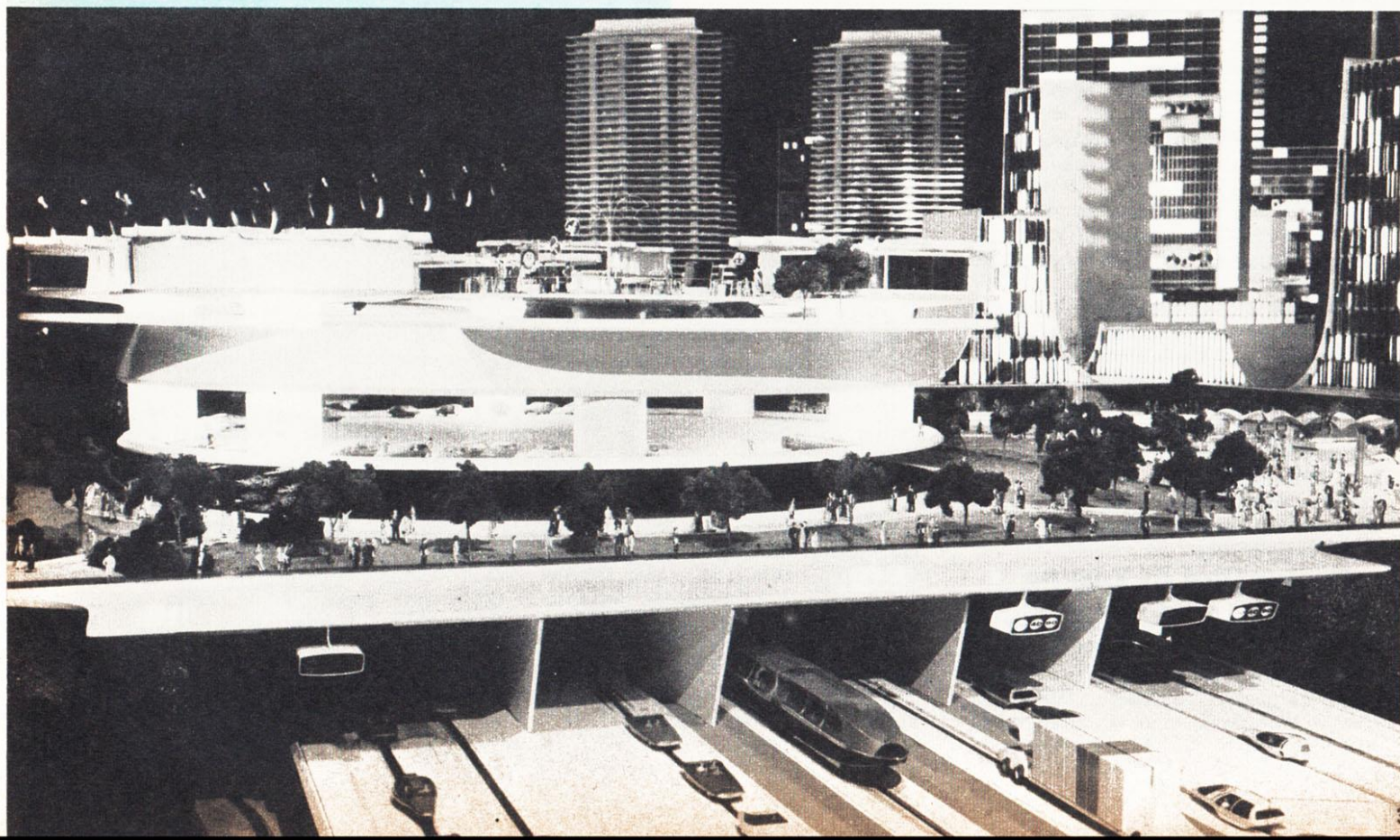
The city was on the move—literally. Each “suburb” was a separate, beetle-shaped steel monolith mounted on enormous tubular steel legs. The thousands of people inside, hardly aware of any movement, carried on their daily lives, quite normally. They were used to it.

At night, all the mobile components of the city, factory areas and living areas, squatted down and were still. Telescopic tubes were extended from one to another, connecting them all. Through these tubes ran everything that normally travels on our roads today from food supplies to joy-riders. In another few days the “walking” city would arrive at its destination, a port where everything its factories manufactured could be shipped away.

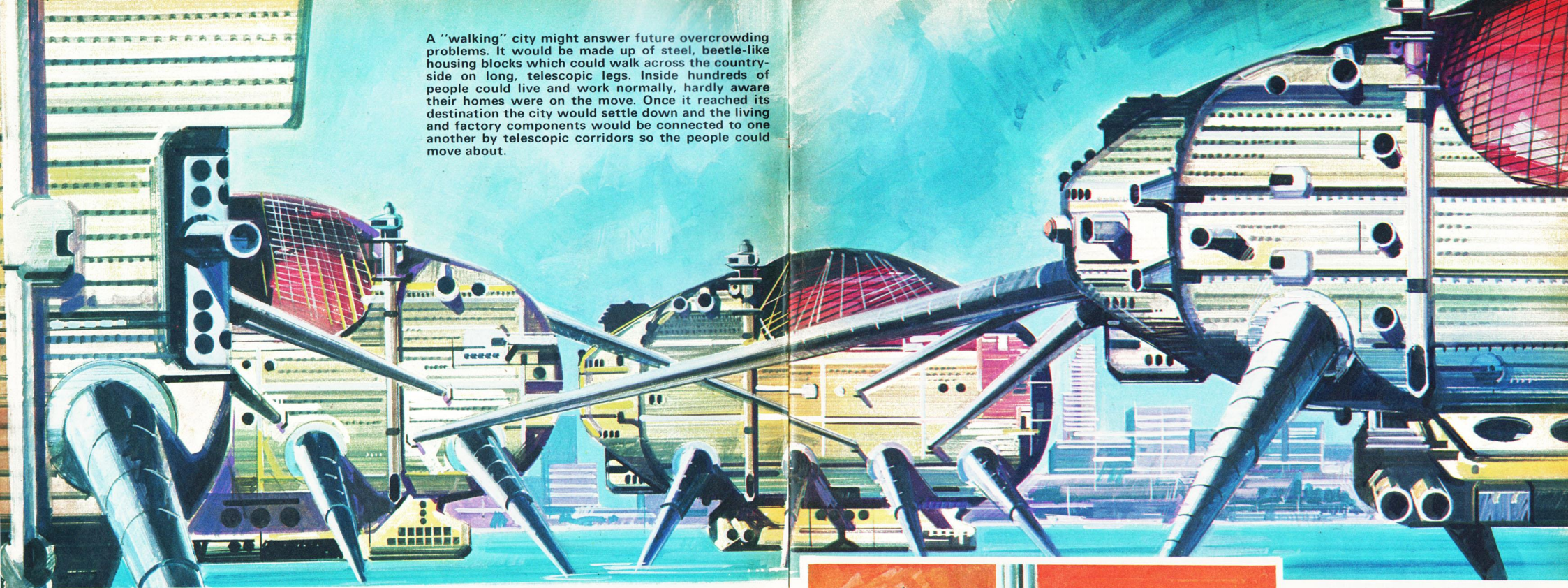
This may sound like science fiction but a lot of people take it seriously. The walking city was designed six years ago. It is one of the many imaginative attempts to design an efficient city that would not have all the problems of today’s.

The problem is so many people want to live in cities they have become overcrowded. They are also taking up too much of our valuable farm land as the suburbs continue to expand. The walking city would save space by concentrating the people while allowing them to be no more than ten minutes from open country.

Modern cities are now spreading out so fast that a new profession has arisen to try and cope with it. Town planners now have the



A "walking" city might answer future overcrowding problems. It would be made up of steel, beetle-like housing blocks which could walk across the countryside on long, telescopic legs. Inside hundreds of people could live and work normally, hardly aware their homes were on the move. Once it reached its destination the city would settle down and the living and factory components would be connected to one another by telescopic corridors so the people could move about.



responsibility of designing living areas that are not only pleasant to live in, but are more efficient as well.

They have a problem on their hands.

Most of us in this country, in America and Western Europe now live in enormous sprawling cities where crowds, dirt and noise are commonplace. In the centre of each one, like a spider in its web, sits the original town.

As more people came to live in them the suburbs were expanded. In this century this expansion has gone on at a frightening rate and the "urban explosion" has been the result. The urban areas, as the built-on outskirts are called, can occupy ten times the space of the original town. When these urban areas, expanding outwards, meet those of another city it can result in a county-wide sprawl of housing.

Collection of Towns

England's Black Country is an example of such a development. Holland's Randstad is another. Los Angeles, U.S.A., is like most other megalopolises, as these giant cities are called. It is really a collection of towns which have grown together. As a result it is possible to drive for 20 miles down one street

A city which can get up and walk off or one which can control its own weather—both could be an accepted way of life in the future!

passing through a number of towns, without seeing open country.

Los Angeles, which is a comparatively modern city, is unusual in that it has tried to solve the bane of modern cities—traffic congestion. Its roads are an engineer's dream come true but—it has buried hundreds of miles of countryside under concrete. Only one-third of the city's area is taken up by living space. The rest is road. A man may have to drive 40 to 50 miles a day just travelling to and from work.

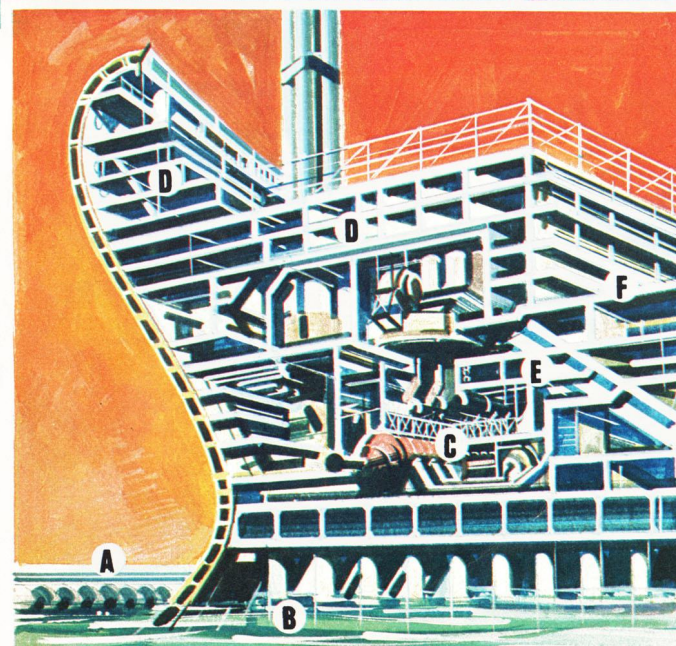
It is to avoid building even greater areas of housing, and to cut down on unnecessary commuting, that town planners have designed and built the New Towns like Cumbernauld, in Scotland. This town is typical of modern ideas in town planning. It is compact. Built on a hilltop, it houses 70,000 people who live in residential blocks. The town centre is multi-level and is approached by traffic-free pedestrian ways. Had these special homes been separate council houses they would only have in-

creased the urban sprawl. The real problem with Cumbernauld, as with many other New Towns, is a social one. The new citizens do not know each other and loneliness is a problem. A community spirit cannot be built into a new town and can take years to develop.

Space-Saving Towers

New Towns, which siphon off the over-spill from larger ones, are one weapon in the fight to make modern life more humane. There are far reaching plans to reconstruct whole areas of the megalopolises. Space-saving tower blocks of flats are erected and the ground surrounding them landscaped if possible. Planting greenery is one way of combating the dreary sameness of housing estates.

One of the major causes of the expanding suburbs is the flight from the centre. Higher living standards have resulted in everyone



wanting to live as near to the country as possible. It is better to live among greenery than among bricks and mortar. This has meant in the past that the countryside vanished under mushrooming housing estates.

An early attempt to stop this process was the "Green Belt". This idea treated cities as circular clusters of buildings each of which was to be surrounded by a broad belt of open country. It is no longer so popular, in over-populated Western Europe. As travel speeds increased, workers found they could commute from beyond the Belt. Inevitably, small towns expanded rapidly—and began eating through the Green Belt towards the metropolises.

An alternative scheme at bringing city-dwellers nearer the countryside is the Linear City. This bold design calls for old cities to be re-modelled and new ones to be built in narrow belts. This would do away

This is a Sea City—built far out in the North Sea and providing homes for 28,000 people. Horseshoe-shaped, its lagoon would be encircled by a single block of buildings 180 feet high. Water inside the lagoon would be heated artificially to control the climate. (A) Floating breakwater to lessen waves. (B) Sluices to control heated water in central lagoon. (C) Power centre. (D) Houses. (E) Areas reserved for industry. (F) Hotel.

with the acres of asphalt we have in the centres now, but it would make travelling to other parts of the city longer.

To overcome the lack of a central point in a Linear City one group of planners have introduced the idea of a star-shaped layout. This would, in effect, bring the countryside almost to the heart of the metropolis. The centre, essential for easy business transactions, would be no more than two-and-a-half miles from the nearest piece of greenery.

Recurring Problem

While town planning is not new (Orange in France, built by the Romans, is an example), it has never received so much attention as it does today and in the rush to deal with the crush all ideas are welcome. It has been calculated that there are over 34 megalopolises around the world with populations of well over three million. Four of these—the London, Ruhr, Tokyo and New York areas—have ten million people or more trying to live in them. So, ideas for dealing with the problem keep popping to the surface. Some, like Wilem Frischmann's "Tower" city, could be built now.

His brainchild is a tower two miles high which could house up to 300,000 people. Each would have 850 levels with 100 families to each level. Travel up and down the tower's core would be by cubicles clipped to a central power line.

The city of the future will contain so many millions of people that it will have to be made up of cells, just like a living creature! Each cell would be a self-contained community some 2,000 yards square, about the size of an old medieval city! At the centre would be shops, clubs and churches. On the edge would be schools, sports grounds and light industry. The white cells are residential areas and the black cells government buildings, universities and city services.

How would you like to live two miles up in the sky? That would be the height of this Tower City, already a technical possibility. Each tower would have 850 floors and house 300,000 people!

Such a tower, if built, would certainly save space but it would bring new problems in its train. One of the reasons for the unpopularity of the new "high-rise" flats is the lack of neighbourliness. It is difficult to get to know neighbours who live upstairs. This lack of friendships can cause great loneliness which can bring great mental and emotional problems in their turn.

Fascinating as these imaginative suggestions are they are unlikely to be built in the foreseeable future. The present trend in planning is to decentralise as far as possible. By moving work-creating industries out into the country and building well designed homes for the workers near them it is hoped to relieve the congested centres.

Another development, popular in France and America, has grown as a direct result of traffic-choked streets. Hypermarkets, huge supermarkets that sell everything from food to furniture, have been built sometimes miles out of town. The normal process of shopping has been reversed. Instead of travelling into the crowded centres shoppers can go the other way.

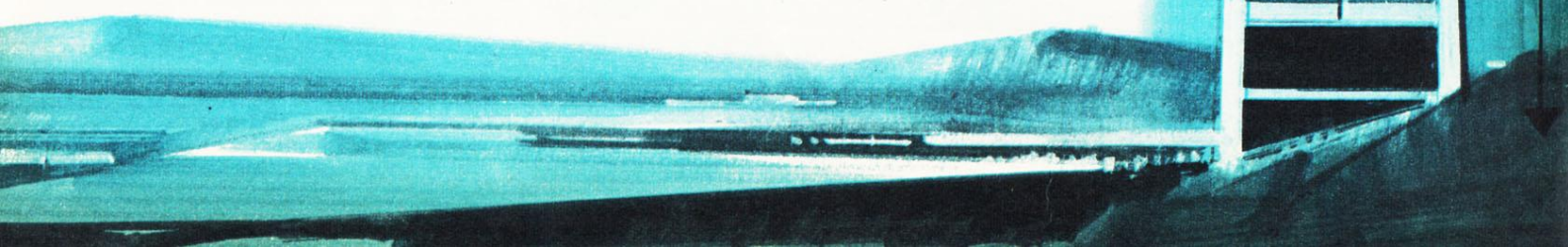
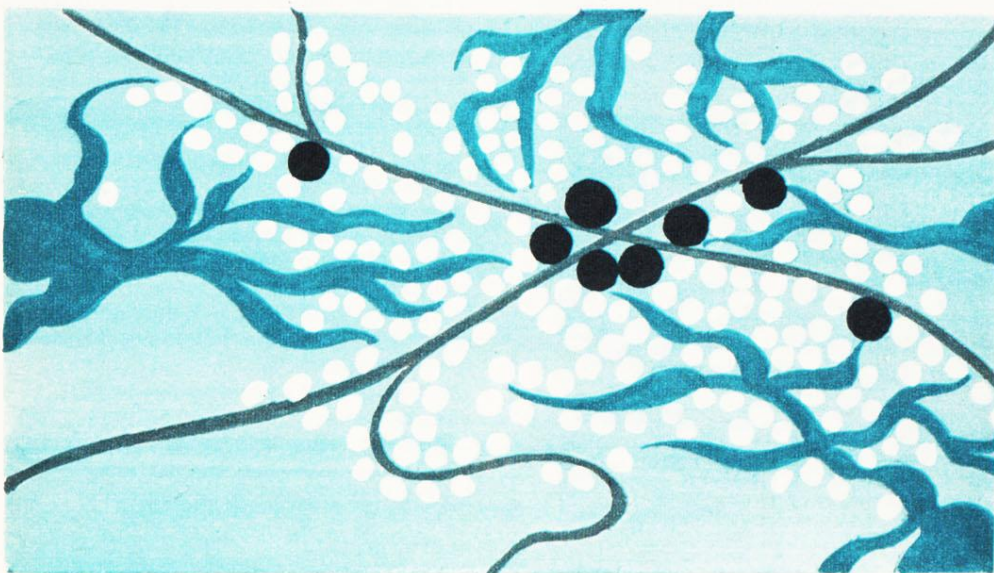
OUR CROWDED CITIES—the most populated areas in the world.

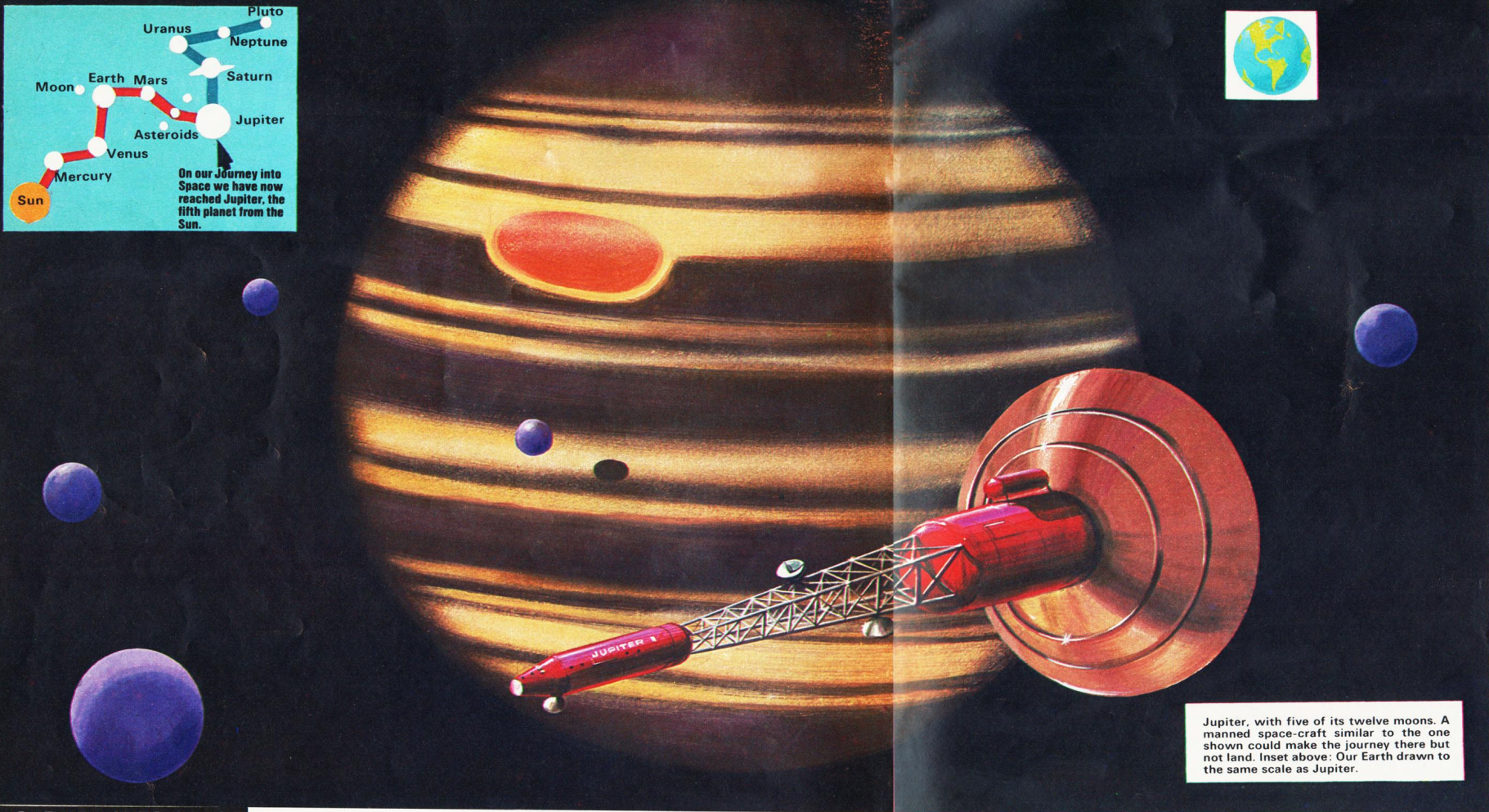
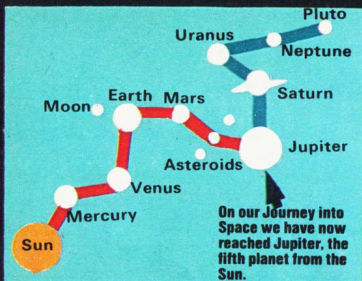
New York-N. Eastern New Jersey: 14,759,000 people. Tokyo-Yokohama 13,628,000. London 11,547,000. Rhine-Ruhr 10,419,000. Paris 7,810,000. Randstad, Holland 3,937,000. Cairo 3,500,000. Hong Kong 3,133,000.



The Empire State Building drawn in scale

2 MILES





Jupiter, with five of its twelve moons. A manned space-craft similar to the one shown could make the journey there but not land. Inset above: Our Earth drawn to the same scale as Jupiter.

JOURNEY INTO SPACE

JUPITER—THE GASSY GIANT IN

Our Grand Tour of the Solar System is taking us now into the deeper wastes of space. Our home planet Earth is a long way behind us, and the Sun itself has dwindled to the apparent size of a billiard ball.

It is cold out here, and very lonely. But ahead of us are some of the most fantastic sights in the Universe, and the emptiness must not put us off.

For we are in the realm of the gas

giants—the planets so unlike our own that it is almost impossible to conceive of them.

King of these giants is JUPITER, named in fact after *Jove* (or *Jupiter*), the king of the gods.

And worthy of the name the planet is, for its size is greater than that of all the other planets put together.

It orbits the Sun at a distance of nearly 507 million miles, and even though it is such an immense distance

from the Sun it is still one of the brightest objects in our night sky. The reason for this is partly its size, and partly the fact that, like Venus, it is shrouded in a dense atmosphere that reflects light brightly.

Jupiter is a splendid sight with the naked eye, and an even better one if a telescope or binoculars are used.

Small instruments are not powerful enough to show details (a properly-mounted reflecting telescope must be

OUR SOLAR SYSTEM

Everything about Jupiter is big – its size, its crushing pressures, its twelve moons and a pull of gravity which could make you weigh nearly a ton!

used for this), but it is possible to see its circular shape and several of Jupiter's moons.

There are four of these which can be usually seen (if you have exceptional eyesight, you might even be able to see them with your naked eye), and these are called *Io*, *Europa*, *Ganymede* and *Callisto*.

Through a large telescope, Jupiter itself is a unique sight. The whole of its visible surface is covered with wide

bands of coloured material, each of which runs roughly parallel with the equator.

At first this puzzled astronomers, but an explanation was soon found.

The fact is that Jupiter has a very fast rate of rotation. Its day is only ten hours long. This, coupled with the immense size of the planet, means that the surface will be moving at many thousands of miles an hour.

Planet-Wide Gales

This fast rotation has another effect, which is to make the planet more than 5,000 miles wider in diameter at its equator than it is between its poles. In other words, the planet appears to be slightly "flattened".

But the effect on Jupiter's atmosphere of this rotation is to create huge, planet-wide gales, which stream continuously in bands across the whole surface. And these are what we can see.

One of the most prominent features is the famous "Red Spot".

This is rather a misnomer, since this "spot" is 25,000 miles long and 7,000 miles wide! It has been in more or less continuous view since we have been observing Jupiter, and it is generally acknowledged to be a permanent or semi-permanent feature.

What it is actually created by is hard to say, though there are several theories.

It is thought that it is not on the actual surface of the planet, but in the atmosphere. One theory suggests that it might be the outpourings of some immense volcano.

Immense Pressures

Another idea is the "raft" theory. That is, that it is a raft of relatively lighter material floating on the denser atmosphere below.

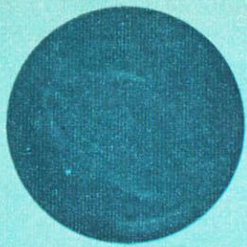
Yet another theory suggests that it might be a phenomenon known as a *Taylor's Column*. A permanent feature on the surface, such as a huge mountain, could be creating turbulence in the atmosphere and throwing up a cloud of dust or gas.

But what is the planet made up of?

Before considering that, we must remember that the vast size of Jupiter will create immense pressures and a gravity approximately twelve times that of Earth's. (A normal man would weigh nearly a ton on Jupiter!) So that the materials comprising the surface will be in a very different state from what they would be on Earth.

The atmosphere itself is probably ammonia, ice and water-vapour, though there will be hydrogen, helium and methane also present.

Beneath this there will be a layer of liquid or solid hydrogen, which will be under immense pressures. Thousands



Jupiter is orbited by twelve moons, but scientists believe that the very outer two are really asteroids which have been captured from space by the planet's immense gravitational pull.

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of miles below this there will be the metals and rocks of the core.

Let us imagine our spaceship has brought us to the region of Jupiter. Can we land?

The answer is almost certainly no. In the case of most of the other planets, we can imagine how it may barely be possible for us to land there one day.

But on Jupiter the conditions are almost entirely hostile to Man. Any ship which tried to land would have to be capable of withstanding the crushing gravity, immense pressures, freezing temperatures and absolutely unknown conditions on the surface itself.

Jupiter's Moons

Even if a ship could land there, the men inside it would not be able to survive the gravity.

It is possible, though, that one day in the future we will find some way of building an anti-gravity device, and it is just possible that this could get men safely down to the surface and up again.

But in the foreseeable future, the special attraction of Jupiter is its twelve moons. Almost small planets in their own right, these moons will provide us with a grandstand view of Jupiter.

In addition to the four we have already mentioned, the moons' names are: *Amalthea* (nearest of all to Jupiter), *Hestia*, *Hera*, *Demeter*, *Adrastea*, *Pan*, *Poseidon* and *Hades*.

On these moons we will not only have an almost unlimited area of exploration, but will be able to take really precise measurements of Jupiter itself. Unmanned probes could be sent to selected areas with pinpoint accuracy, and low-orbit satellites could be launched.

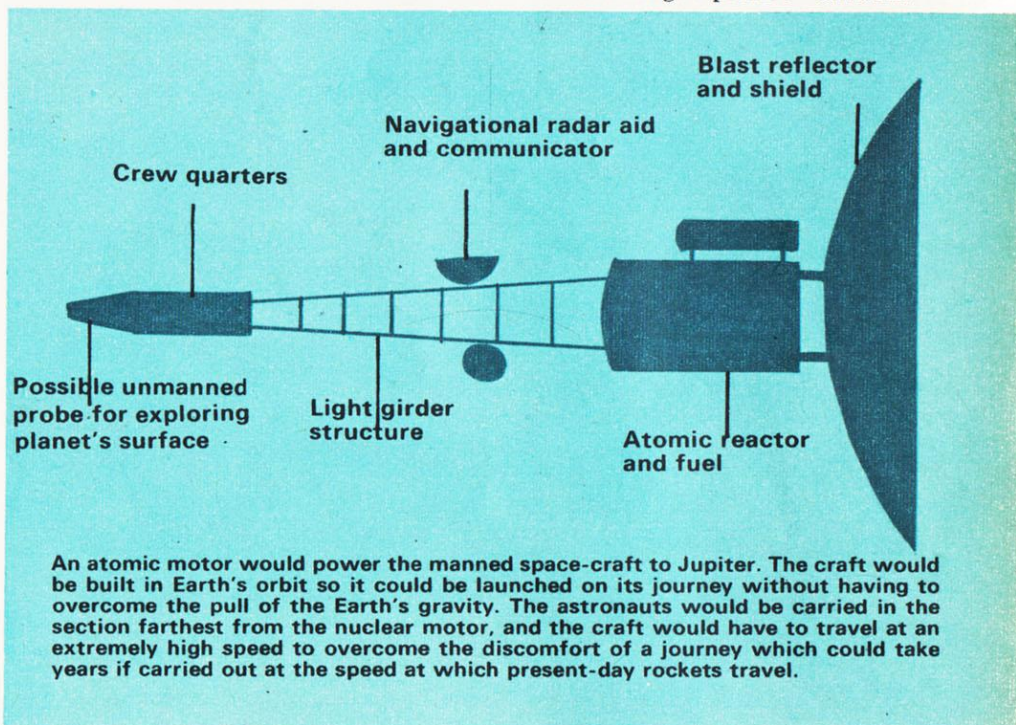
But would there be life on Jupiter?

At first thought the immediate answer would be in the negative. But consider that the environment there is so

different from our own, that there may well be a kind of life which would be completely different from ours. Such a life-form is very possible, though how we could ever meet those "Jovians" and how we could communicate with them is another story.

Our sights now are set farther out. For beyond Jupiter, even farther from the Sun, is another gas giant—and the strangest and most beautiful of all.

The ringed planet—Saturn.



ENGLAND'S GREAT DICTATOR



Continued
from
page 15

content. "His faithful friends," wrote the Venetian ambassador, "insist on his never sleeping in the same room, and frequently changing his bed for fear of some mine."

When a new Parliament was summoned, Cromwell took special precautions to ensure that all its Members were his supporters. One of them, an Irish Member, Colonel Jephson, proposed that Cromwell be made King. But three senior army officers warned Cromwell that the army would mutiny if he accepted, and the Lord Protector declined the offer.

Instead, he became Lord Protector for life, with the right to name his son as successor. In fact, his son Richard did succeed him, but Tumbledown Dick, as he was called, had no liking for the job and he was deposed by the army generals in favour of the new King Charles II.

Oliver Cromwell himself did not enjoy his "reign" for long. By the summer of 1658 it became evident that he was dying.

In August he took to his bed, and died on 3rd September, the anniversaries of his two great victories in the field, Dunbar and Worcester.

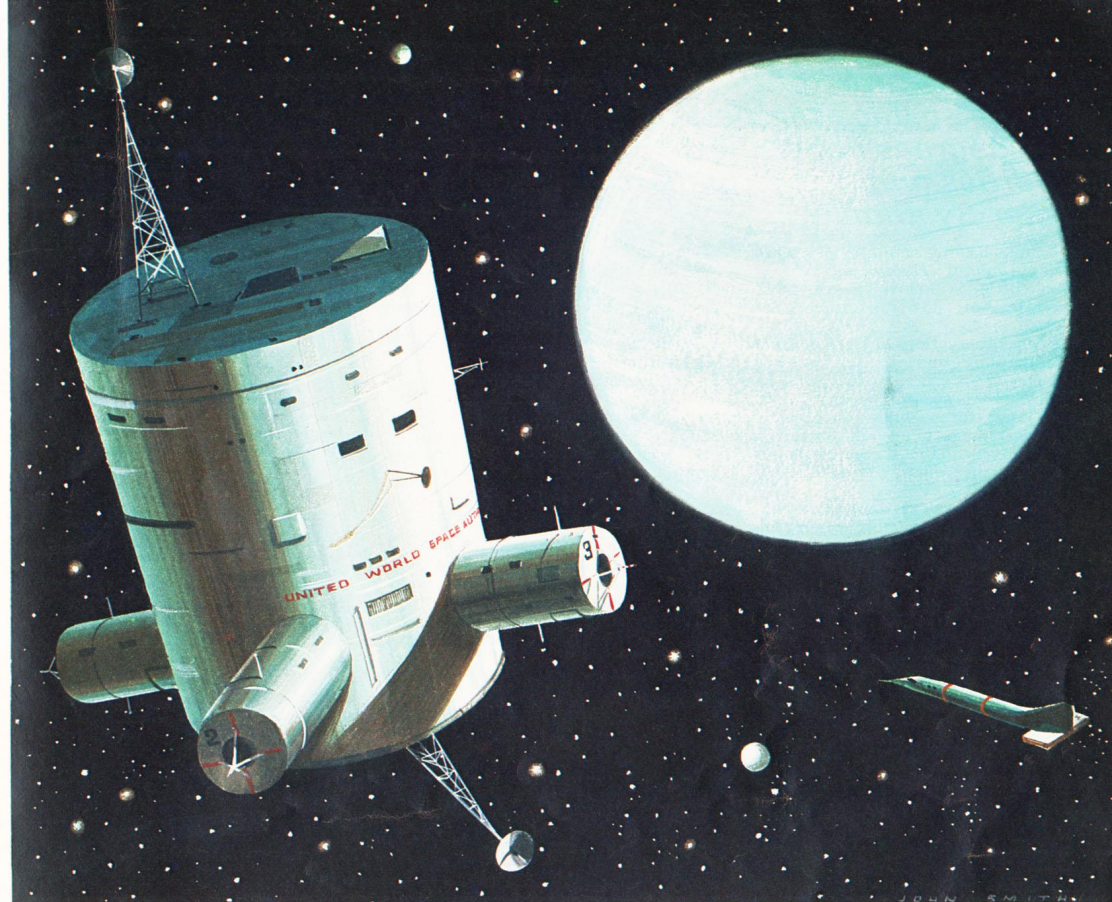
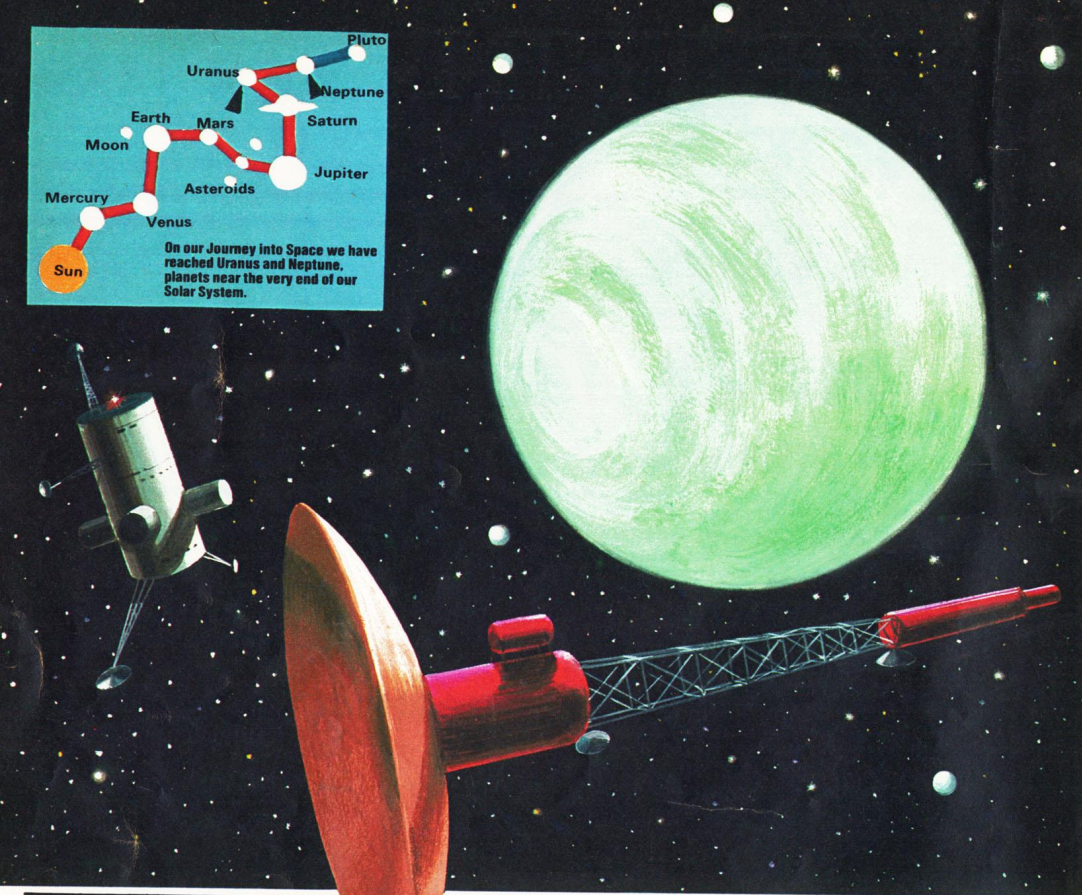
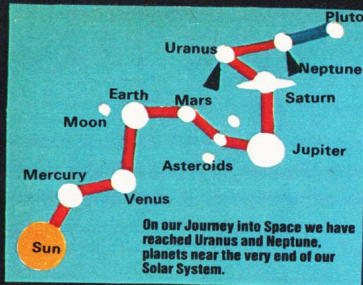
The long term effect of Oliver Cromwell's life on the story of England was undoubtedly a good one, for no more could vain kings ride roughshod over the will of the people. But perhaps on his death bed he had some doubts about the way he had used his great power. For he asked of one of his chaplains, "Tell me, is it possible to fall from grace?"

The chaplain answered, "No, it is not possible."

"Then," said the dying Cromwell, "I am safe, for I know that I was once in grace."

At this the men of Salisbury seized their city and declared their allegiance to the exiled King. An army was sent to suppress them. Offenders were either hanged or transported overseas for life, as slaves in Barbados.

Cromwell's health at last broke under the strain of coping with all the dis-



JOURNEY INTO SPACE

INTO THE UNKNOWN

When the men from Earth finally go out to the planets of the Solar System, there will be a great temptation in their minds to stop their journey at Saturn. For surely there could be nothing to interest Man beyond the ringed planet? We have examined those planets reaping most warmth from the Sun, and found them unlikely to possess life. And those gas giants like Jupiter and Saturn where a strange form of life may be, even if it is beyond our understanding.

What can the outer planets offer Man?

Throughout history, one of the most basic drives has been a quest for understanding of the unknown. This has led him to the exploration of new lands, scientific discoveries and completely new kinds of technology.

It is this same quest for the unknown

that will take Man out beyond Saturn, into the darkest part of the sky.

Here he will discover lonely and frozen planets: first URANUS, then NEPTUNE and finally PLUTO. What he will discover here may be, for all we know, every bit as exciting as anywhere else in the Solar System.

Amateur Astronomer

This week our Grand Tour will anticipate what the Americans may find with their unmanned craft that will be launched in 1977, and consider the first two of these.

Uranus was first sighted in 1781, by a man named William Herschel. At this time Herschel was an amateur

astronomer and it was this discovery that launched him on his brilliant career.

It is a fact that is little appreciated that amateur astronomers play a really vital role. It was so in Herschel's day, and it is so now.

When Herschel announced his discovery he caused a major sensation, for the existence of a planet beyond Saturn was totally unforeseen. Uranus is only visible to the naked eye when our atmosphere is unusually clear, and even then it looks like a very small and insignificant star.

Viewed through a telescope, Uranus is still a disappointing sight. The largest reflecting telescopes will show it only as a small and faintly greenish

Uranus and Neptune—planets which are buried so deep in the inky blackness of space that they appear only as dots when viewed through even our most powerful telescopes!

disc . . . and no surface details as such can be made out.

However, with modern instruments astronomers have been able to make precise measurements.

Uranus orbits the Sun at an average distance of 1,783 million miles—or just under 20 times as far as the Earth's orbit. Because it is such an immense distance from the Sun, surface tempera-

tures are likely to be very low indeed: about -190 degrees Centigrade, or -310 degrees Fahrenheit.

The diameter of Uranus at its equator is 29,300 miles, and its "day" is about 10 hours and 48 minutes. This means that the planet is rotating very quickly indeed, with the result that, like Jupiter, it is slightly "flattened" at the poles.

One unusual thing about Uranus is

To make a close study of Uranus (left) and Neptune (right) vast orbiting space stations would be needed, supplied by space craft ferrying scientists and supplies to and from Earth.

that its North Pole is farther south than its South Pole!

This is because its axial tilt is 98 degrees . . . or more than a right-angle. (For comparison, the axial tilt of Earth is only $23\frac{1}{2}$ degrees, which because of our relative closeness to the Sun gives us a broad belt around the Equator known as the Tropics.)

Lucky Accident

For sake of uniformity, scientists describe the North Pole of a planet as being the one which, when viewed from above, appears to be rotating in an anti-clockwise direction. In Uranus's case, this pole is the one eight degrees below the plane of the ecliptic, and is thus farther "south" than the other pole.

Uranus, with a North Pole farther south than its South Pole, and Neptune, with a surface temperature of minus 360 degrees Fahrenheit, are interesting oddities among the planets of our Solar System.

Uranus has five satellites: *Miranda*, *Ariel*, *Umbriel*, *Titania* and *Oberon*. Very little is known about these, though their positions have been plotted.

It was observations of Uranus which led, almost by accident, to the discovery of Neptune.

Uranus was seen to "wander" in its orbit, and for a while astronomers were at a loss as to account for this. It could only mean that there was *another* planet farther out, exerting a gravitational pull.

After many calculations, they were able to estimate roughly where this theoretical planet should be.

When, in 1846, the planet was actually sighted, it was found to be very nearly in the estimated place!

Neptune orbits the Sun at about 2,793 million miles (or 30 times as far as Earth) and no surface features can be detected with present equipment. To a modern telescope it presents a bluish disc.

Two Satellites

The diameter of Neptune is 31,200 miles, and it rotates once in every 14 hours. It follows, therefore, that it too is probably "flattened" by the speed of its rotation.

Temperatures are even colder than on Uranus, probably being as low as -220 degrees Centigrade, or -360 degrees Fahrenheit. From Neptune, the Sun would appear to be little more than an immensely bright star.

There are two satellites of Neptune:

Triton and *Nereid*. Triton is roughly the same size as our own Moon, and it is possible that because of the low temperatures it has been able to retain some form of an atmosphere.

Well, can we land on either Uranus or Neptune?

This question cannot be answered with any certainty. In each case, the gravity is approximately twice that of Earth, so in theory it would not be too uncomfortable for men to stay there, at least for short periods.

Frozen Atmosphere

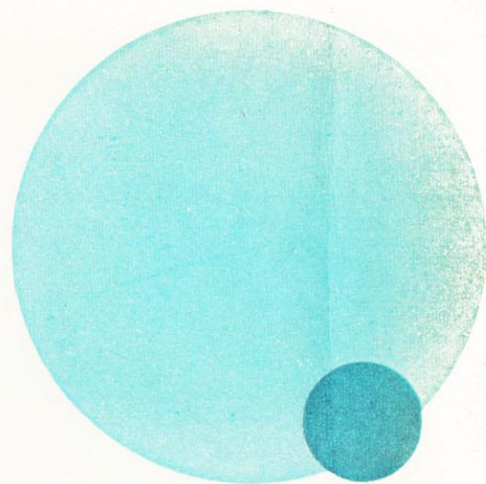
The big imponderable on both planets is the atmosphere. It is not easy to say exactly what makes up their atmospheres, though it is a fair assumption that they will not be too dissimilar from Jupiter or Saturn.

If there is any atmosphere there which has not frozen into liquid or solid, the extremely fast rotation will almost certainly have whipped it into planetwide gales, and this would make a landing very hazardous.

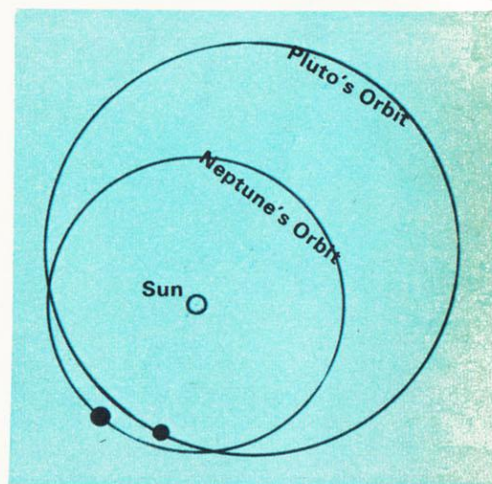
Of course, astronauts from Earth could almost certainly make a landing on one or other of the planet's satellites, and when eventually Man travels as far as these remote gas giants this is probably what he will do.

But if he is to land on Uranus or Neptune, he must step with caution.

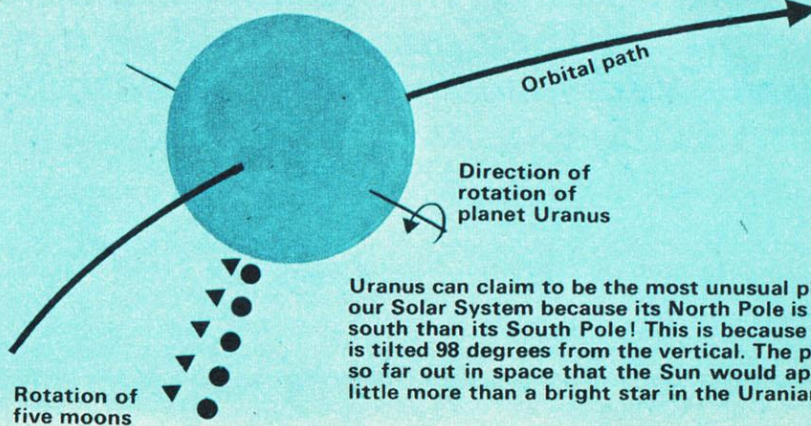
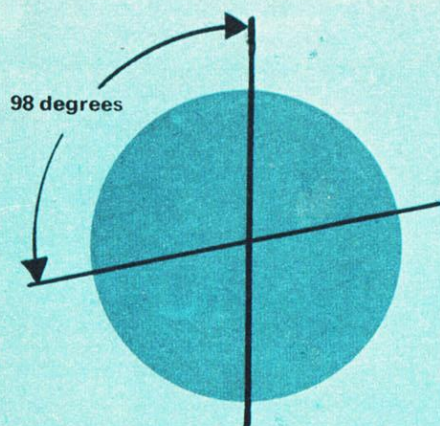
Beyond these two there lies the planet Pluto and it is to there we will be going next week. For in Pluto, perhaps, lies the greatest mystery of them all!



Uranus and Neptune are almost the same size, but both are considerably larger than our planet Earth, shown here as the small, dark disc.



Although it is Pluto and not Neptune which is the last planet in our Solar System, it is Neptune which remains the greatest and most constant distance from the Sun. As the diagram shows, Pluto travels much farther out but also comes closer to the Sun than Neptune.



Uranus can claim to be the most unusual planet in our Solar System because its North Pole is farther south than its South Pole! This is because its axis is tilted 98 degrees from the vertical. The planet is so far out in space that the Sun would appear as little more than a bright star in the Uranian sky!

A LIFE ON THE OCEAN FLOOR

That's the experience of a team of underwater scientists who are unravelling the secrets of the sea

Although the Moon is nearly a quarter of a million miles away from the Earth we know more about its surface than we do about the beds of oceans such as the Atlantic and the Pacific. Indeed, men have already walked about on the Moon, but no human being has yet strolled along the bottom of, for example, the mid-Pacific, which at its deepest is less than seven miles.

For centuries men have been tantalised

by the problem of unravelling the mysteries of the ocean depths. Today, science is overcoming many of the problems that must be solved before man is able to move freely about the world's seabeds.

Once man can explore and prospect the beds of the oceans as he can now do on land, there are tremendous prizes to be won. The sea floors cover a veritable treasure house of oil and every kind of mineral needed by industry.

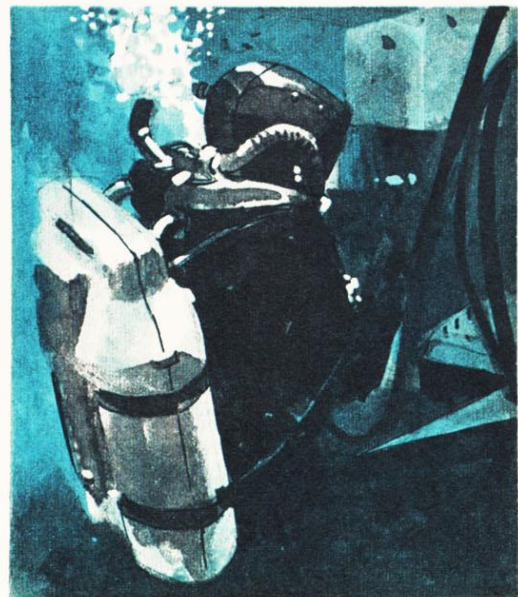
The barrier that stands between man and the enormous seabed wealth is pressure. With modern breathing equipment, divers



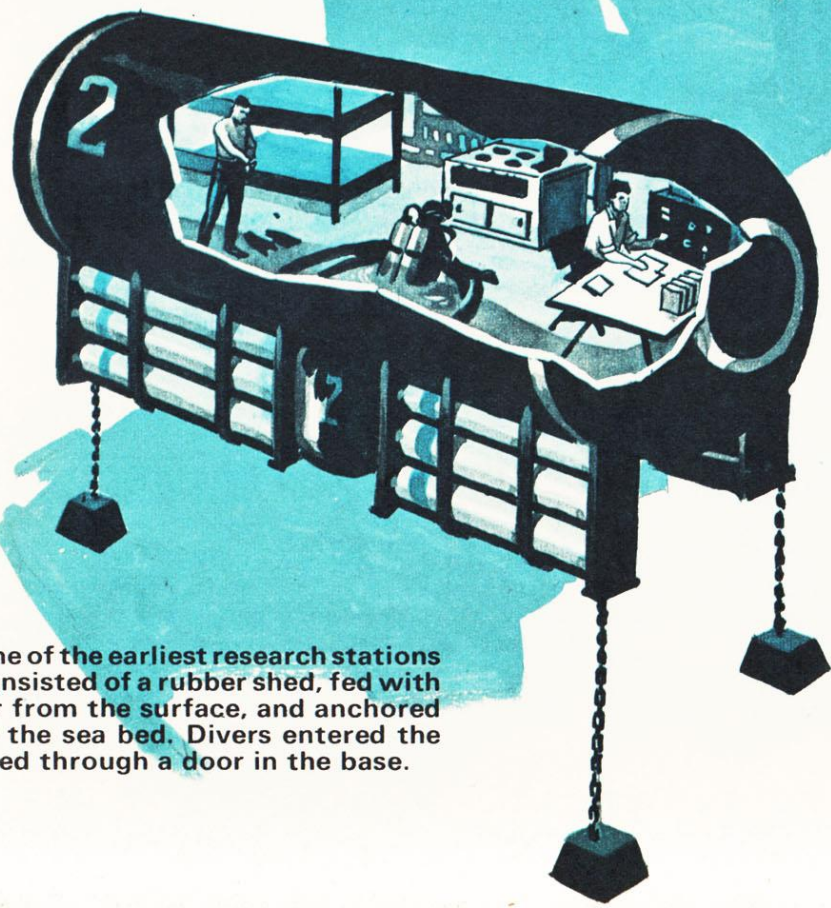
One of the divers prepares to go down to the underwater station.



Ready, steady . . . This may be the last sight of land for two months.



Arriving at the house on the ocean floor, he enters through a door on the underside.



One of the earliest research stations consisted of a rubber shed, fed with air from the surface, and anchored to the sea bed. Divers entered the shed through a door in the base.

could descend to the lowest depths of the ocean, but the most efficient breathing apparatus would not protect a diver against water pressure, as we explained in *WORLD of WONDER* No. 68.

And even though heavily armoured suits enable divers to descend to great depths divers still have to spend several hours in a decompression chamber on reaching the surface so that their bodies can adjust slowly to the change in pressure.

Roughly speaking, divers have to spend eight hours in a decompression chamber for only one hour on the sea bed.

This is obviously a waste of the divers' skills. So American scientists hit on the idea of providing divers with houses on the seabed to enable them to work, sleep and eat for several days at a time without coming to the surface.

Underwater House

The first underwater house consisted of a rubber shed, rather like a balloon, anchored to the sea floor. Air was pumped into the shed at high pressure to prevent it from collapsing under the pressure of the sea. A door at the bottom of the shed allowed the divers to enter or leave, the pressure of the air inside the balloon preventing the sea water flooding in.

A rubber tube, called an umbilical cord, supplied the shed with the air from the surface. Fresh water came through another tube and there was a telephone line to the mother ship above. A cable carried down electric current for lighting and for an electric stove on which the divers' meals were cooked.

Later an improved underwater house was built which did not have its air supply pumped down from the surface. Instead, the gases which provided the breathing mixture and inflated the rubber house were contained in cylinders beneath the balloon-like structure.

During one test of the underwater house, called *Sealab II*, three U.S. Navy divers under the command of a former spaceship captain, M. Scott Carpenter, remained at a depth of 205 feet for 30 days. At the end of the trial, they had to spend two days in a decompression chamber; but they would have had to be decompressed for the same length of time if they had been under the water for only an hour.

Seabed Towers

In April last year, a much more ambitious saturation-diving experiment was carried out by the U.S. Navy off the Virgin Islands in the Caribbean. An entirely new type of underwater house called *Tektite I* was used. A few weeks later an improved version, *Tektite II*, was launched.

The name Tektite comes from the meteor-like objects that fall from space into the sea. This name linking the diving experiments with space is particularly appropriate because the seahouses are being used to test the reactions of men who would be in a confined space on voyages to Mars.

Tektite II, which is very similar to *Tektite I*, consists of two steel cylinders, each 18 feet high and 12 feet in diameter,

connected by a steel tunnel four-and-a-half feet in diameter. The cylinders, which are really towers, are mounted on a steel base, which also holds the tanks of gases that make up the breathing mixture. The whole structure is anchored to the seabed with 87 tons of lead ballast.

Each of the towers is divided into two rooms, one above the other. The bottom floor of one tower contains the divers' quarters furnished with bunks, chairs and a table; there is also a small library and a cine-projector.

Above the crew quarters is the control centre, which includes a well-equipped

laboratory for examining and analysing specimens collected by the divers. The control room also contains medical equipment for testing the effects of long-duration diving on the crew.

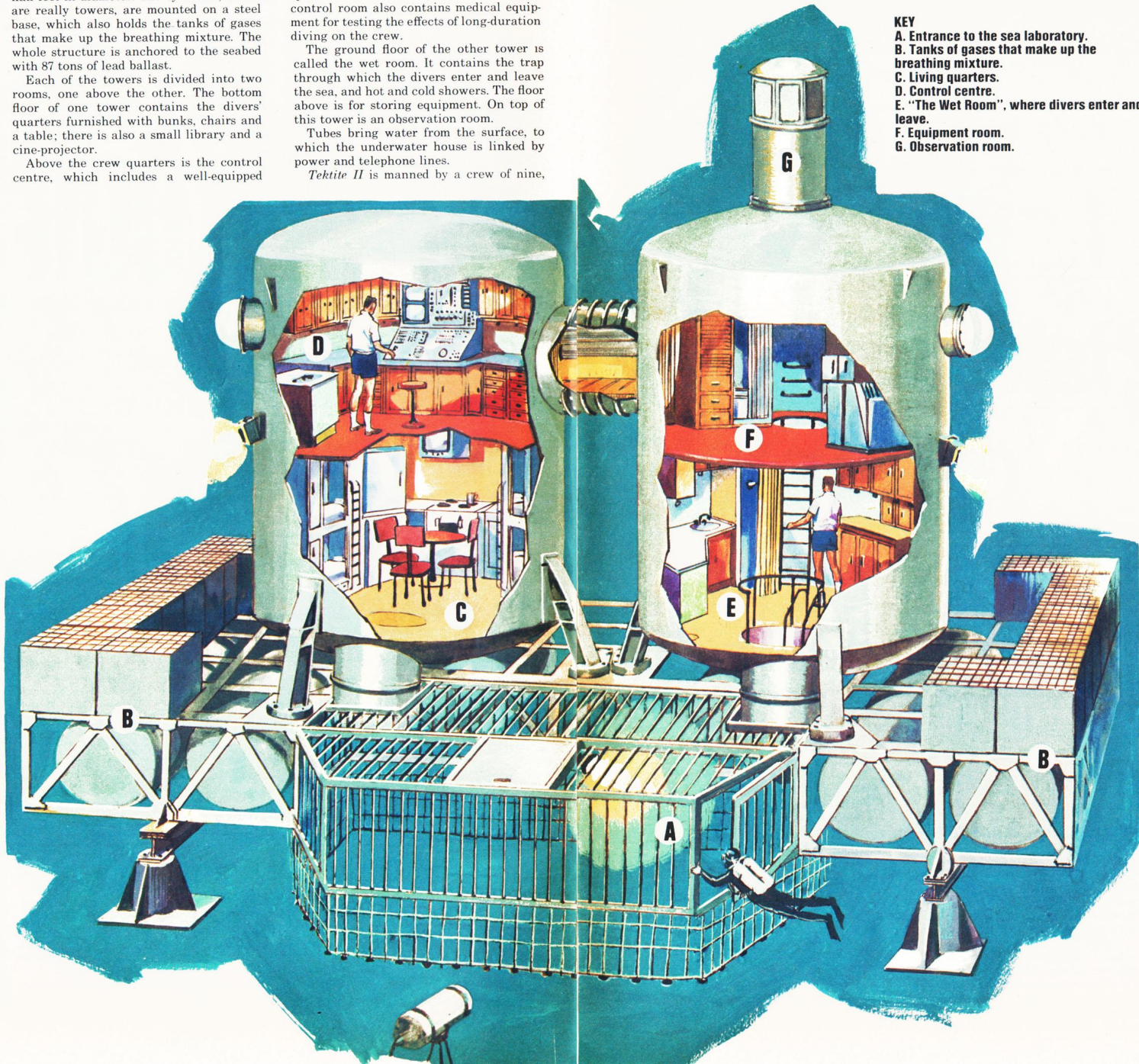
The ground floor of the other tower is called the wet room. It contains the trap through which the divers enter and leave the sea, and hot and cold showers. The floor above is for storing equipment. On top of this tower is an observation room.

Tubes bring water from the surface, to which the underwater house is linked by power and telephone lines.

Tektite II is manned by a crew of nine,

KEY

- A. Entrance to the sea laboratory.
- B. Tanks of gases that make up the breathing mixture.
- C. Living quarters.
- D. Control centre.
- E. "The Wet Room", where divers enter and leave.
- F. Equipment room.
- G. Observation room.



who remain at the bottom of the sea for two months. The aquanauts, as the divers are called, are under constant observation from the surface ship by means of closed-circuit television.

Besides testing new diving equipment and breathing gases, the aquanauts operating from *Tektite II* are carrying out research programmes in marine mapping and geology, studying the habits and behaviour of fish and other marine creatures, and measuring the speed and movements of underwater currents.

As well as being expert divers, the aquanauts manning *Tektite II* are all specialists in some branch of science.

Tektite II is in some respects an international project. Some of the equipment was made in Britain and other European countries, while the crews include divers from Britain, Canada and Australia.

Working In The Depths

So far, the greatest depth to which divers from *Tektite II* have worked is 250 feet, but plans are being made to get the underwater house down to 600 feet. Even that does not represent the limit. Scientists in charge of the project believe that improvement to the underwater laboratory will enable it to form a base for divers operating at 1,000 feet.

At the end of their two-month stay on the seabed, the aquanauts are hoisted to the surface in a special diving-bell which locks on to a decompression chamber on the mother ship. Each man has to spend 30 hours or more in the decompression chamber while the pressure is brought back to normal.

Tektite II is, in fact, turning men into sea creatures and the compression chamber turning them back into land creatures. The purpose of the *Tektite* project is to find out whether or not man can really live and work at the bottom of the sea.

As divers become more accustomed to working and living at the bottom of the sea, they will venture farther and farther away from their underwater home.

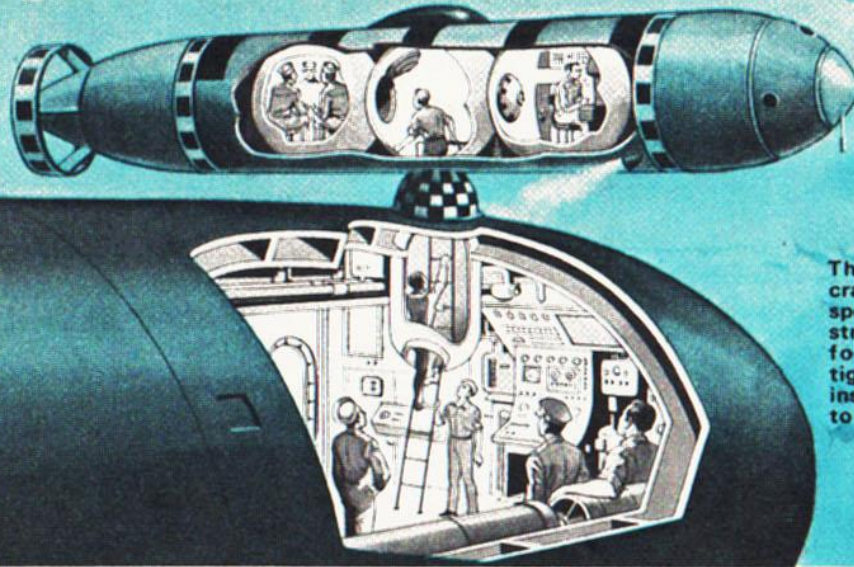
Undersea Bus

For these distant underwater expeditions, the divers will have their own submarine transport. For short trips they will use an undersea scooter now being built. It consists of a torpedo-shaped body with a propeller driven by an electric motor. The diver will sit astride it and use handlebars to guide it.

Longer journeys will be made in the underwater bus shown on the cover. This is really a miniature submarine driven by electricity. The crew ride inside and can operate two arms fitted with mechanical fingers for lifting objects off the ocean bed. While travelling in their submarine bus the crew will not wear diving suits or air cylinders as the miniature submarine provides all the air needed.

But in spite of the marvels of saturation diving and the efficiency of underwater houses, man is still a long way from the day when he may walk about the seabed seven miles below the surface of the water. But scientists are convinced that in time that ultimate dream of the diver will be realised.

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The small rescue craft locks onto a special hatch on the stricken submarine, forming a water-tight seal so the men inside can scramble to safety.

SUB-SMASH! THE SIGNAL FOR ACTION

and outside pressures prevents the submarine from being crushed by the water pressure.

Inside the hull are three sphere-shaped compartments. The forward one is the control room, manned by a pilot and co-pilot; the centre sphere has in the bottom a hatch leading out of the hull and surrounded by a flexible skirt. The centre and third spheres are to accommodate the rescued crews and have room for 24 men and two medical orderlies.

When the signal "Sub Smash" is received at a naval base, a nuclear submarine is sent to the approximate position of the disaster. At the same time, a transport aircraft carries the submarine lifeboat to the search area.

The D.S.R.V. is next lowered on to the deck of the nuclear submarine and secured in a cradle. Acting as a mother ship, the nuclear submarine then submerges, carrying the D.S.R.V. pick-a-back on its deck.

By means of echo-sounders and a special homing device, the mother submarine starts searching for the sunken submarine.

The mother submarine cannot submerge to depths comparable with those for which the D.S.R.V. is designed. So when the mother submarine's detecting equipment shows that the crippled submarine lies below her, the D.S.R.V. takes over.

The pilot of the submarine lifeboat pulls a lever which releases his vessel from the mother submarine and dives. At the same time he switches on homing equipment which brings his vessel immediately over the disabled craft.

The underwater lifeboat is then manoeuvred until its flexible skirt at the bottom of the hull is directly over an escape hatch on the deck of the stranded sub. A magnetic anchor is released from the submarine lifeboat and fixes itself to the deck of the submarine in distress. Next, a suction device locks the skirt over the sunken submarine's escape hatch.

After that, the inside of the skirt is pumped dry and the air pressure inside both submarines is equalised. The hatches are opened and the men from the disabled submarine climb up a ladder into the rescue sub.

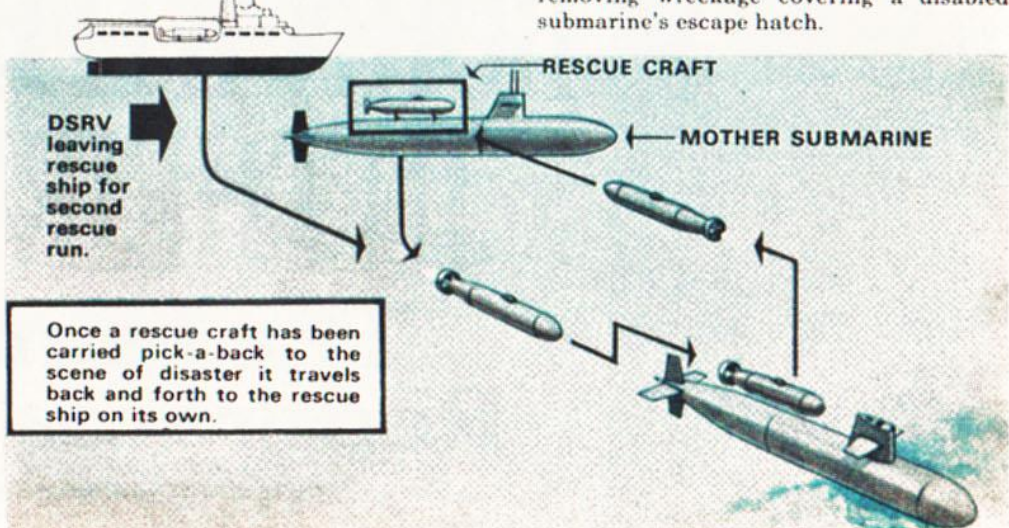
Then the D.S.R.V. rises and meets its mother submarine, to which it locks itself

on. Again carried pick-a-back, the submarine lifeboat is taken to a special rescue ship.

The rescue ship is built like a catamaran so that the submarine lifeboat can surface between the two hulls to transfer the rescued crewmen. Across the sterns of the catamaran's twin hulls is a helicopter deck from which the survivors are flown ashore.

Although the submarine lifeboat can take on only 24 men at a time, it can rescue a crew of 156 officers and men in 17 hours.

The performance of this first underwater lifeboat has been so successful that the U.S. Navy is building a fleet of ten. Some will even have mechanical arms, remotely controlled from inside the vessels, for removing wreckage covering a disabled submarine's escape hatch.



ATOMS GET AIRBORNE

Just one ounce of uranium would be needed to power an atomic aircraft across the Atlantic— provided we can stop the passengers becoming radio-active!

When the Concorde airliner makes its maiden flight across the Atlantic, its turbo-jet engines will burn over 50 tons of fuel. If the airliner had been powered by atomic engines, the journey could be made on an ounce of uranium.

No wonder aircraft designers are tantalised by the possibility of harnessing atomic energy to aircraft. We already have atomic-powered ships and submarines, so why not atomic aircraft?

Unfortunately, applying atomic, or nuclear energy to aircraft is a much more difficult matter than doing the same for ships.

Three problems must be solved before the atom-powered aeroplane can graduate from an idea on a drawing board to an operational airliner. The weight of the reactor to release the atomic energy and the engine to use it must be kept low; the whole power plant must be of simple design and easy to operate; and there must be efficient shielding to prevent the escape of dangerous radiation from the reactor.

The atomic power plants used on ships and submarines weigh several hundred tons. That weight would be quite out of the question for airliners.

Nevertheless, scientists and aircraft designers of several nations are desperately seeking a solution to the problem of atomic-powered aircraft. Great Britain, the U.S.A. and Russia are leading the race to be first in the air with a nuclear aeroplane.

Atomic Prototypes

In Great Britain there are aero-nuclear laboratories working on light-weight reactors and shielding for aircraft, while several American firms have built small prototypes of atomic aero-engines. The U.S. Air Force has already tried out a small reactor mounted in a B36 bomber.

Although the U.S. Air Force reactor does not actually power the bomber, it is providing valuable information about shielding and the effects of atomic radiation on materials, controls and instruments.

There are several ways in which atomic energy could be applied to aircraft. The most promising is to split plutonium or uranium atoms to produce the heat which in an ordinary jet engine is obtained from the burning of kerosene or other liquid fuel.

In one design for an atomic aero-engine, a fan sucks air into a system of piping surrounding the reactor. The heat generated in the reactor by the splitting of the atoms causes the air in the piping to expand, so that it flows with tremendous force from the

rear of the engine to push the aircraft forward.

Another design makes use of a steam engine, which at first thought seems a most unlikely power plant for an aeroplane. Not only is a steam engine the heaviest engine for the power it produces, but it needs a great weight of oil or coal for fuel.

Yet some designers believe that if the

problem of atomic propulsion for aircraft is to be solved it will be by combining a steam engine with a reactor. This could be done by using the reactor heat to produce steam to drive a turbine. The turbine would in turn drive a propeller mounted on the end of the turbine shaft.

In order to save weight of water, the steam would be condensed back into water after leaving the turbine. This would mean, however, the fitting of a condenser and a refrigerating system to provide cooling for the reactor. On top of this there would be the weight of the anti-radiation shielding.

Although the weight of reactor-shielding, condenser and refrigerating system would be high, the designers of the engine claim that by using special metals and other materials, their atomic-steam power plants would give more power per pound of engine weight than the heaviest jet-engine now in use. The weight of the fuel would hardly be worth considering as a few ounces of uranium or plutonium would keep the engine going for weeks at a time.

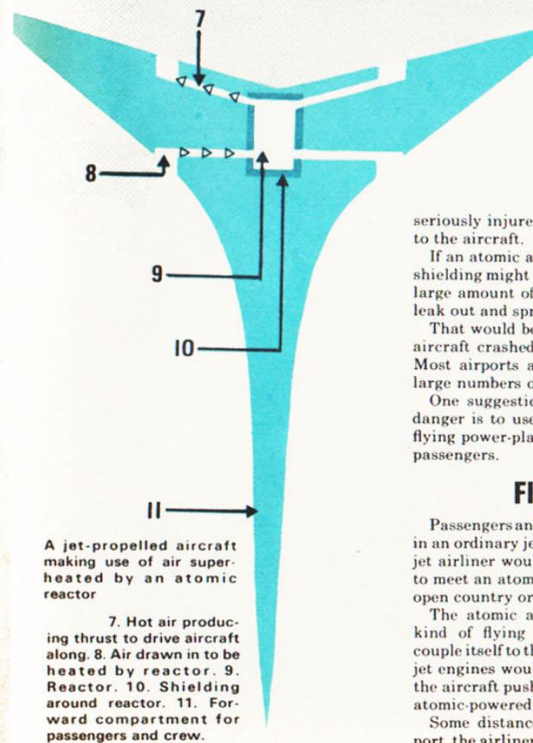
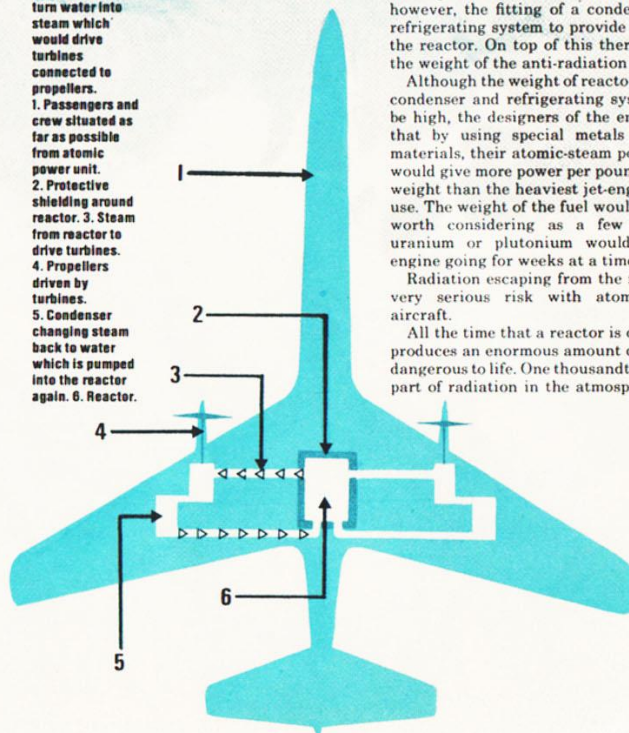
Radiation escaping from the reactor is a very serious risk with atomic-powered aircraft.

All the time that a reactor is operating it produces an enormous amount of radiation dangerous to life. One thousandth-millionth part of radiation in the atmosphere would

Atomic aircraft, acting as tugs, could be used to push along jet aircraft which had made a conventional take-off. Once the atomic tug had been automatically docked, the airliner would shut off its engine until near its destination. Then the tug would unlock itself allowing the airliner to make a normal jet-powered descent and landing.

A steam-powered airliner? An atomic reactor could be used to turn water into steam which would drive turbines connected to propellers.

1. Passengers and crew situated as far as possible from atomic power unit.
2. Protective shielding around reactor.
3. Steam from reactor to drive turbines.
4. Propellers driven by turbines.
5. Condenser changing steam back to water which is pumped into the reactor again.
6. Reactor.



seriously injure, or even kill, anyone close to the aircraft.

If an atomic aircraft crashed, the reactor shielding might get cracked. In that event, a large amount of radio-active matter would leak out and spread over a wide area.

That would be particularly serious if the aircraft crashed on landing or at take-off. Most airports are near big cities, so that large numbers of people would be affected.

One suggestion to reduce the radiation danger is to use atomic aircraft simply as flying power-plants carrying a crew but no passengers.

Flying Tug

Passengers and freight would be embarked in an ordinary jet airliner at an airport. The jet airliner would then take-off and fly out to meet an atomic aircraft somewhere over open country or the sea.

The atomic aircraft, which would be a kind of flying tug, would automatically couple itself to the jet airliner. The airliner's jet engines would then be switched off and the aircraft pushed to its destination by the atomic-powered flying tug.

Some distance from its destination airport, the airliner would release the coupling

holding it to the tug aircraft, switch on its jet engines and fly off under its own power to land at the airport in the normal way.

Meanwhile, the atomic-powered tug aircraft would remain airborne ready to pick up another jet aircraft for the return flight. In this way one nuclear-powered tug could ferry several jet airliners across the Atlantic or Pacific oceans without itself ever having to land except to change crews.

To reduce the risk from radiation, atomic-powered air tugs would not operate from airports, but would be based and serviced at aerodromes which were a safe distance from cities and other populated areas.

Indeed, the aerial tugs probably would be big enough to accommodate several crews, who would work in watches like the crew of a ship. This would enable the tugs to remain airborne for several days or even weeks shuttling airliners backwards and forwards along regular routes.

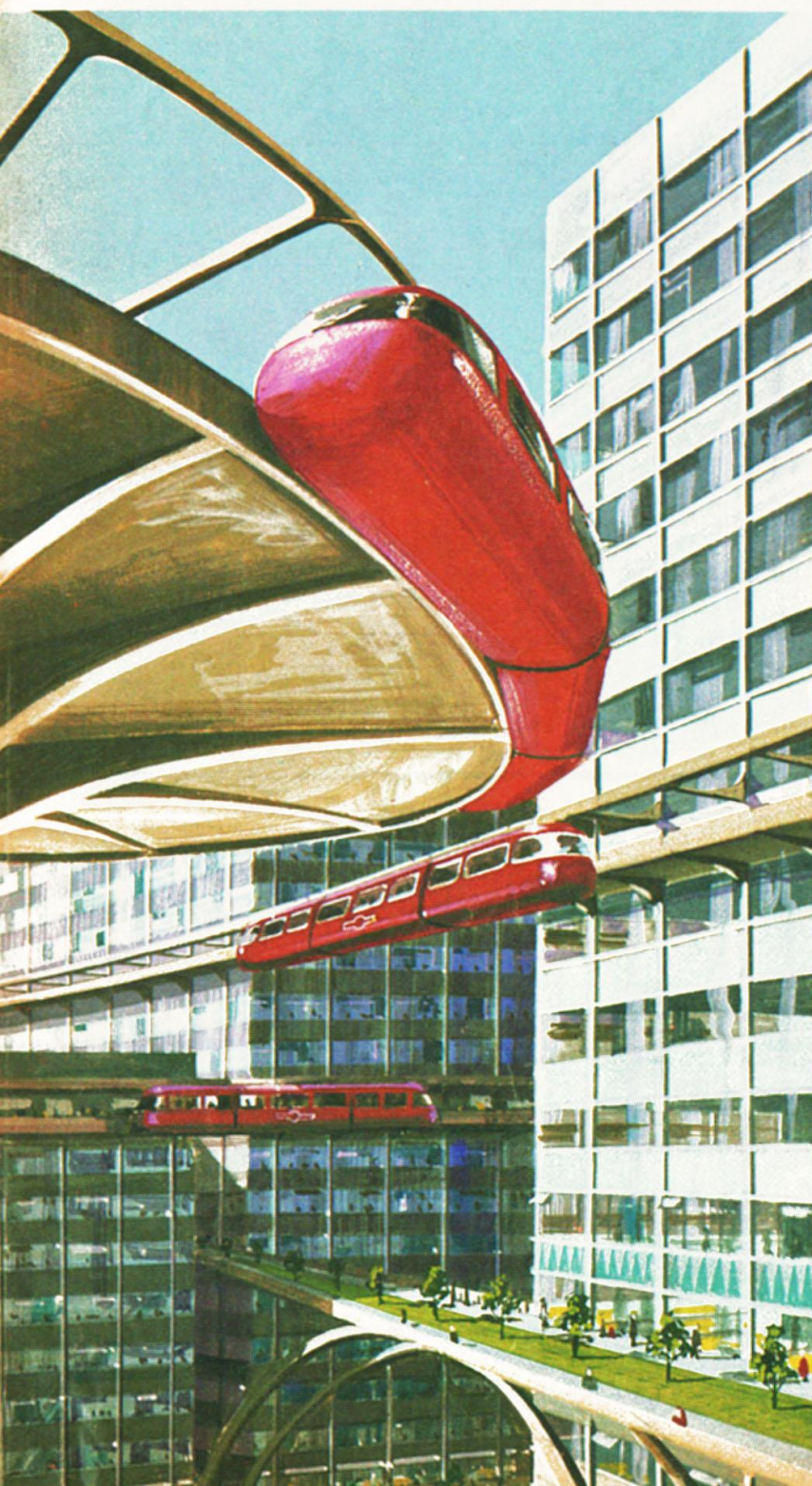
Atom-powered tug aircraft would have the great advantage that the jet aircraft they pushed through the sky would be able to carry a bigger load of passengers and freight, because the airliners would have to carry only enough fuel for the flight to and from the meeting place with their tug and the point where they separated.

WORLD of WONDER

Incorporating TREASURE

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Beginning this week —

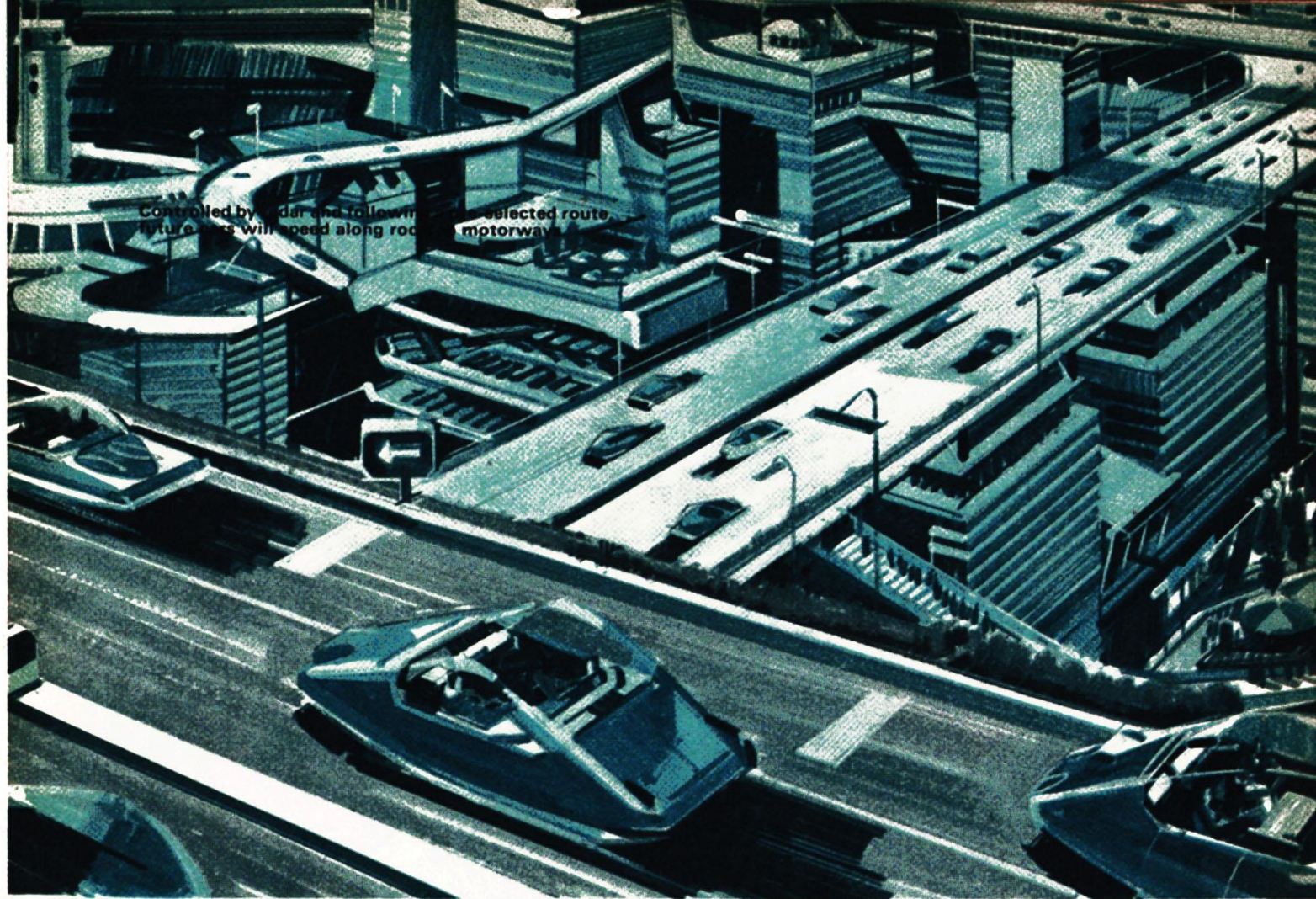
futurescope

A fascinating new series which gives a glimpse of life in Tomorrow's World.

For you it could mean travelling inter-city by monorail. Commuting to the office along highways in the sky. Visiting a push-button supermarket to do the shopping.

For a further look into the future turn to page 3





Controlled by radar and following selected route
future cars will speed along road motorway

futurescope

No. 1

Over the next few weeks we shall be taking a look at what life in tomorrow's world may be like for you and your children. For a start it seems there will be less work and more play, and soon we could all be . . .

LIVING A LIFE OF LEISURE!

The great aim of science in the modern world is to make life simpler and easier, to take the boring drudgery out of it, and give everyone more time in which to enjoy themselves.

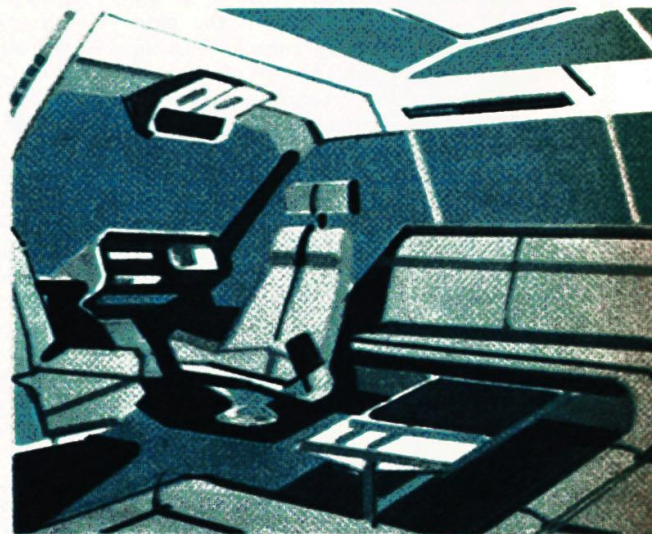
Already, in the 1970s, a tremendous amount of progress has been made. People today enjoy far more leisure and lead far easier lives than previous generations ever dreamed of.

However, science has never been content to stand still, and in the future there will be even less drudgery than there is now, and even more ingenious machines for making life easier.

For example, one of the most annoying experiences of life today is chugging along a road jammed with traffic.

In the future, this sort of thing simply will not happen. There will be more motorways and so traffic will be able to move along at a far brisker and far steadier pace. These roads will not pass through towns. Nor will they go round them. They will run on top of them!

Already, in Tokyo, the Japanese have built 17 miles of rooftop roadways,



Inside the cars passengers will be able to relax in comfort, free from fear of collision as the speed and position of the traffic around them is automatically adjusted.



The flat tops of large buildings will be used as playing fields and recreation centres. Many people will own helicopters and fly to work before parking on top of their offices.

and in 1959 the architects of the Pilkington Glass Age Committee designed a whole town, called Motopia, in which the roads were built on top of great blocks of flats.

The pattern of Motopia is laid on a grid measuring about 1,200 feet by 800 feet. At the junctions of the grid are roundabouts with ramps leading down to and up from the town's access roads. The roof-level roads are 17-feet-wide dual carriageways, with hedges and barriers 3½ feet high on each side.

The cars travelling along these roads will not be "driven" in the same way as the cars of today. They will be radar-controlled and will drive themselves along pre-selected routes. Their radar systems will also enable the cars to adjust speed or position where necessary in order to avoid collisions.

In addition to owning self-driving cars, many more people will own private helicopters.

The Pilkington Glass Age Committee foresaw this when they designed Skyport One. This is a large-scale helicopter terminal, to be built in the centre of cities. The form of Skyport One is that of an enlarged-roof skyscraper with landing platforms thrusting up into the air on glass and concrete stalks.

Designs like this electrically powered invalid chair are forerunners of personal transport systems which people will use to travel about vast office blocks and down miles of corridors.



cooking and washing-up directions, and will even control the waste and rubbish disposal.

However, all these time-, energy- and labour-saving devices do create a problem: what are people going to do with all the leisure hours at their disposal?

They could, of course, take longer holidays than people do now, and they can be far more certain to get good weather. For there will be huge artificial "holiday islands" which will have powerful motors to "drive" them to wherever the Sun shines most brightly.

Leisure Centres

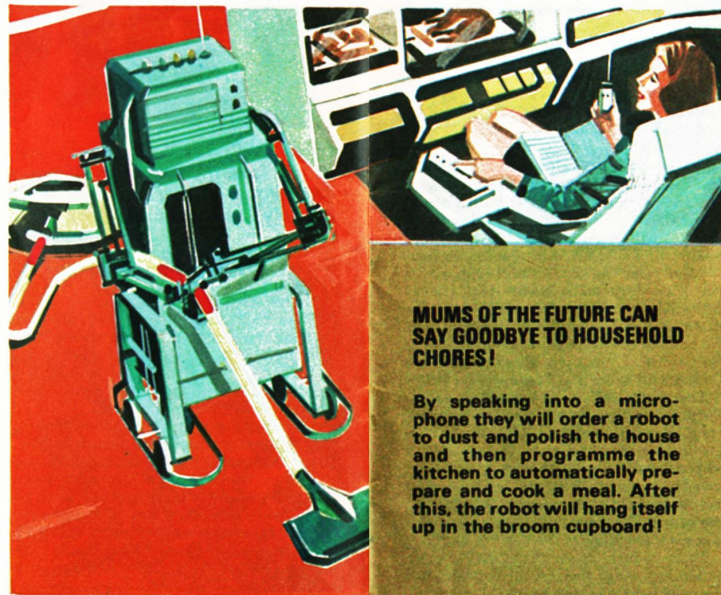
Back at home, people will be able to spend their time in large leisure centres which will cater for many different types of activity all under one roof.

Already, there is one such centre in use - Billingham Forum near Stockton-on-Tees.

In the Forum's sports halls, people can play basketball, badminton, tennis, netball, volleyball, five-a-side soccer, table tennis and several other games. They can practise judo, fencing, golf, archery and rifle-shooting, skate on the ice-rink or watch plays, films, ballet, concerts and opera in the theatre.

There will be many centres like Billingham Forum in the future, and they will be a very important feature of life. For it is a great mistake to think that leisure is just a matter of doing nothing or watching television for hours on end.

"Leisure," as someone once said wisely, "is working hard at something else."



MUMS OF THE FUTURE CAN SAY GOODBYE TO HOUSEHOLD CHORES!

By speaking into a microphone they will order a robot to dust and polish the house and then programme the kitchen to automatically prepare and cook a meal. After this, the robot will hang itself up in the broom cupboard!



For people with time on their hands huge self-propelled "holiday islands" could be the answer. The artificial islands could travel to wherever the Sun was shining, while cargo airships (see *WORLD OF WONDER* No. 59) kept them supplied with goods and hovercraft ferried the leisure-seekers back and forth.

Already a reality, this observation tower allows people in everyday clothes to visit the bottom of the sea! Sunk into 36 feet of water, the tower is fitted with thick glass windows. People are carried by an escalator to the bottom and there they can study and enjoy the colourful world of marine life.

SOIL OR NO SOIL, FARMER GILES KEEPS TRAVELLING ON!



Under a burning African sun the long line of tractors grinds to a halt. They have taken two days to reach this spot and now it is time for the travelling farm to grow some food!

In WORLD of WONDER No. 73 we took a look at the most up-to-date farming methods in an article entitled Whatever happened to Farmer Giles?. It seemed that Farmer Giles had become highly mechanised and many of his everyday tasks were being carried out by machines. But even he would be surprised by the revolutionary farming techniques which lie just around the corner. Already we have soil-less farms and now scientists are predicting that in future our foodstuffs might even be grown on travelling farms!

A long line of giant tractors clattered over the African plains. A future farm is on the move. They've been driving slowly towards this point for two days. Eventually the vehicles stop in a widely spaced line and soon each one is swarming with men. The travelling farm is about to take shape.

The farm itself will be a collection of enormous plastic tents that will have been unpacked from the giant tractors. Each of these tents, set in rows across the thin soil,

can act as a greenhouse. Each will have its own independent climate.

Inside, farming goes on in the way it does today. Neat rows of vegetables being tended as now. The great difference however is that the farm workers will be as highly mobile as circus folk. Literally, here this season and gone the next.

Humidity can be increased and the temperature lowered by allowing the stream of pumped air to blow through specially wetted screens. The climate in each house, of

course, depends on what type of crop is being grown. It will be whatever happens to suit that particular plant. In this way vegetables impossible to get out of season nowadays can be grown on demand.

Haystacks and fields won't disappear from the world completely though, because the farm without a home will only be necessary in certain countries, and Britain is not one of them. It will be useful in savannah lands and in countries like Siberia for a very good reason. It will prevent thin soil from being overworked. It will be one way of avoiding the creation of more dustbowls such as that in the USA. When first farmed the prairie gave rich crops for the first few years, then eventually nothing. The thin soil, sucked dry by too many harvests, just crumbled and blew away as dust. Travelling farms will avoid this kind of tragedy by

never staying longer than a few seasons. They would have moved on before doing any damage to the soil. By the time they returned it would have regenerated itself.

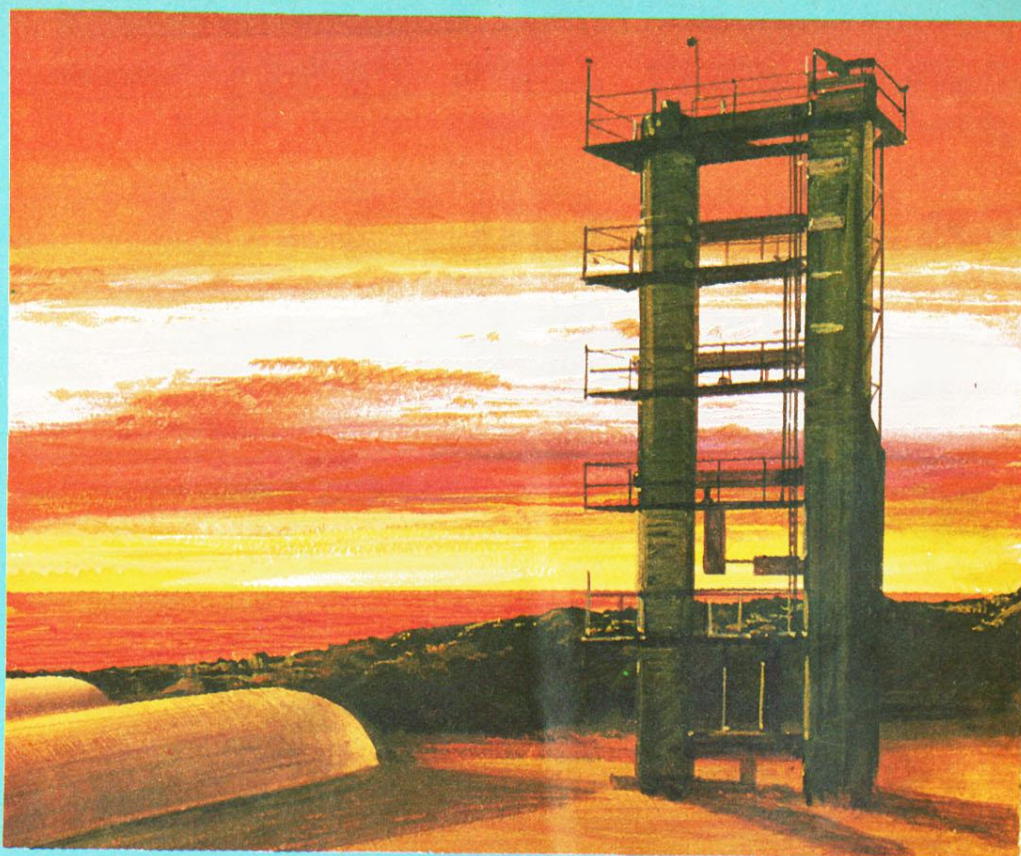
Prairies are not the only places where itinerant farms could be seen. Another kind of site scientists have their eyes on are the thousands of miles of desert which could be made to bloom on exactly the same principle.

Tropical Fruits

Crops grown this way, however, would probably be tropical. The desert heat would be so great that the moisture in the air would have to be raised to counteract it. The result would be a Turkish bath atmosphere of the kind usually found in hot steaming rain forests. Bananas for example would certainly be one of a sand farm's main crops. Each house would be a bit of the Congo in the sands of the Sahara.

Even the sandy beaches around a country's coastline could be farmed once the salt had been washed away. An experimental beach farm set up in Mexico is already

Tons of tomatoes—fresh from the sea shore! Using a desalination plant to turn salt water into fresh water, mobile farms could make use of hundreds of miles of deserted coastline in under-developed countries to grow valuable produce.



Look Mum, no tent poles! Made from polythene film and inflated with air, these plastic greenhouses support themselves. Inside the temperature and humidity can be controlled to grow crops suited to tropical or temperate conditions. Water given off by the plants condenses on the greenhouse walls and runs down into concrete channels to be stored and used again.

putting theory into practice. It has found that plastic sheeting can serve a double purpose. In winter months enough fresh water condenses on the inside to more than offset the amount of fresh water used in irrigation. Climate control in these conditions should present no problems at all. Water might be scarce in the deserts but the farm on the beach can take all it needs from the sea beside it. The special screens which affect humidity can be soaked in salt water without any damage to the crops. The water given off the plants, in fact, is collected as fresh water on the plastic sides of the farmhouse.

Farming Without Soil

The second revolution taking place in farming concerns the soil, or rather the lack of it. By using hydroponics or soil-less farming methods food can be produced in barren areas from the Sahara to the Antarctic and provide means for crops in abundance in those places such as India, Egypt and North African countries where, even with conventional farming methods food production is low.

Soil-less farming owes its being to the fact that Man has been able, over years of research, to accurately chart the life requirements of plants.

If certain mineral salts which, under normal conditions, are drawn from the soil, can be given to a plant and, in addition, it receives water, light and heat, it will grow in any environment.

In practice, hydroponics farms consist of rows upon rows of growth boxes in which the plants, embedded in a "soil" of gravel and sand, are fed with the required mineral salts and water and given the correct amount of heat and light.

Bigger Crops

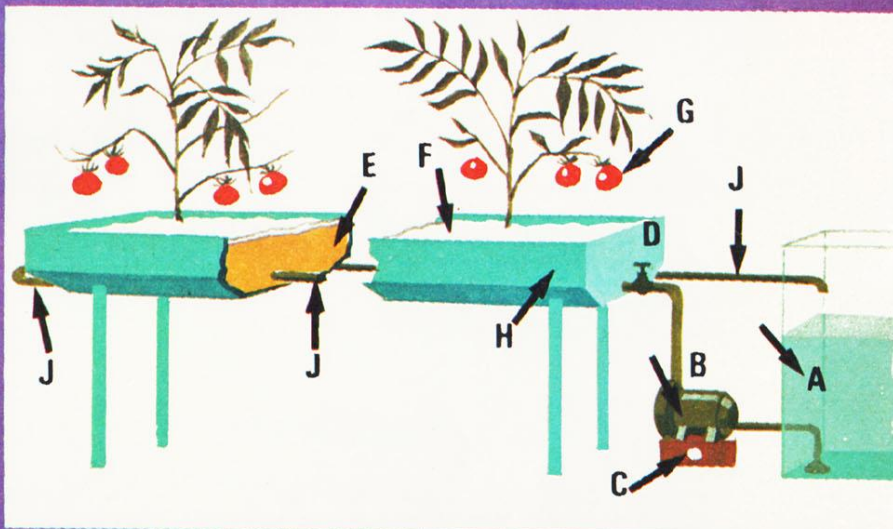
As a result, contrary to ordinary farming where growth rate is dependent on the weather, and where the farmer and crops can be ruined through adverse weather conditions, the cultivation of hydroponic crops is under full control, and not only are results predictable, but yield is far greater than crops grown under normal methods.

Even today crops grown by this method are finding their way on to tables throughout the world.

In the Canary Islands, tomatoes grown under a scheme started by the Spanish Government are regularly exported to other European countries.

The states of Florida and California in America have widespread production of various types of crops in operation and even Mexico, a country that has, because of its weather, adverse farming conditions, leading often to starvation in the past, has a thriving industry in this controlled crop growth.

In a world where food production, under normal farming methods, is rapidly losing the fight to keep up with an ever increasing world population, the importance of the science of hydroponics has been recognised by all nations.



A FARM BUILT ON SAND AND WATER

In hydroponic farming, or soil-less cultivation, the plants feel their way through trays of sand and gravel which are flooded several times a day with water containing all the chemicals plants need. By controlling temperature, humidity and nourishment inside the vast glasshouse, the grower can produce excellent crops whatever the weather.

Chemicals are carefully measured and dissolved in the water to make a nourishing solution (A). A pump (B) started by a time switch (C) forces the solution from the storage tank into the growing tray (D) which is filled with clean gravel or sand (E). A layer of glass wool (F) covers the gravel to keep in moisture and reflect light to speed up the ripening of the crop (G). When the solution rises to a certain level a switch (H) turns off the pump and the solution flows out through the drainage channel and pipe (J) back to the tank to be used again later in the day.

WHAT! NO SNOW, NO ICE, NO ARCTIC!

futurescope

The Arctic is a byword for deadly cold. It is a region that only the hardest men can live in, where men are forever pitted against the cruellest climate on Earth—but not for much longer if the Russian professor, Borisov, and his friends get their way.

They have a plan to defrost the Arctic. If they succeed, the only place to see pack-ice will be at the other end of the Earth, at the South Pole. In the north it will have vanished completely.

If the scheme is adopted it will mean the temperature in the Polar Regions would be raised by 30-35 degrees Fahrenheit. Grapes would grow in southern Canada and Siberia would become cattle-rearing country. It would also open up thousands of square miles of uninhabited tundra to the world's expanding land-hungry population.

The ambitious scheme hinges on the fact that the North Pole is in the middle of what would be an open sea—if it weren't for the layer of permanent ice. Underneath, though, is water. The Arctic Ocean is virtually a basin surrounded on three sides by land, and if it were not for this shape there might well be no ice there at all.

A branch of the warm Gulf Stream flows north towards the open side of the Arctic Ocean—and is lost in the chill flood

An artist's impression of a vital part in the Great Arctic Defrosting scheme. Several hundred of these giant pontoons will be towed to The Bering Straits and bolted together to block the 50-mile-wide gap. Pumps inside the pontoons will force out the Arctic water and as the warmer Atlantic seas flood in, so the North Pole will melt!



Scenes like these could easily disappear if the Bering Straits dam is built, causing a change in the weather and turning the Arctic ice to water!

pouring south. It is this icy current that sweeps icebergs into the Atlantic shipping lanes—and prevents the Arctic ice cap from being melted naturally.

What makes the scheme possible is a comparatively tiny channel at the opposite end of the Arctic Ocean. A passage way, 50 miles wide, separates the land masses of Asia and continental Russia. The great defrosting scheme proposed by the Russians is to reverse the normal current and push the water back through this channel, the Bering Straits. This would allow the Gulf Stream to warm the heart of the frigid sea.

The plan the Russians have hit on is to build a dam across the narrow strait that would hold back the cold water of the northern Pacific. Huge pumps, which would work continuously, will then force the Arctic water out into the Bering Sea. The water pumped out would have to be replaced, and it would be—from the warmer Atlantic.

Pack-ice would begin to thaw almost immediately, enthusiasts say. In any event, they estimate, it shouldn't take more than three to four years to clear the Arctic of pack-ice, once the Gulf Stream is allowed to work unimpeded.

The dam itself would be manufactured in a Pacific port in pontoon sections 250 yards long. They would then be floated north to the site where each pontoon would be

anchored, either by drilling or on piles. The dam itself, while holding back the Pacific's waters, would also interfere with the outward movement of the displaced ice. To help it, the top of the dam would be angled so that the ice could slide up and over it.

All this cold water would, of course, affect the temperature of the Pacific, but not too much the Russians claim. They reckon the effect would be noticeable for only two years—and then it would be no worse than the effect of an unusually cold winter. What is more important to the world, however, is the effect on the height of the sea level once all the Arctic ice has melted. Critics of the scheme say the effect might be catastrophic but the Russians disagree. Their estimates put the all-round rise in the planet's sea-level as being no more than four inches—over 50 years.

Rain On the Tundra

Part of this excess water would, anyway, fall as rain. As the warmer water gradually melts the ice it would produce cloud, which would fall as rain on the normally arid tundra. At present the Arctic tundra qualifies as a desert. Its rainfall is no more than ten inches a year. The scheme would also provide a bonus for another desert, this time

Continued on page 6



Melting the Arctic will change the climate and affect hundreds of square miles of Russian Tundra and the American Far North. Two groups of people who will really notice the difference are the Alaska oilmen, at present working in difficult sub-zero temperatures, and the Yakut trappers, who live and work in the frozen forests of Siberia, often camping out in temperatures as low as minus 90 degrees Fahrenheit!





BEFORE AND AFTER!

Imagine you are on top of the world and looking down on the North Pole! The smaller world (left) shows the pattern of cold and warm sea currents as they exist now. (1) The point where the warm Gulf Stream meets the icy Labrador current which brings down icebergs from the glaciers of Greenland's west coast. (2) The point where the cold currents of the Arctic Ocean (3) meet and defeat the warm North Atlantic Drift of the Gulf Stream. (4) Murmansk—Russia's only ice-free northern port.

The big world (above) shows the defrosting effect of the Bering Straits Barrier (5), which by pumping out freezing water into the Pacific (6) allows the Gulf Stream (7) to warm the area, melt the ice, and leave the North Pole (8) as a point in open water!

The climate around the whole Arctic coast will change dramatically and its effects will be felt as far away as the Sahara desert (9) in North Africa.

WHAT! NO SNOW, NO ICE, NO ARCTIC!

Continued from
page 4

the far distant Sahara. From being an almost waterless zone it would be upgraded into a dry steppe.

The idea of melting the Arctic is not new. Experts have been debating the matter for at least ten years—but no one country can go it alone. Climate-changing would affect too many others. The scheme will need full international co-operation, particularly between Russia, Canada and the United States.

The Gulf Stream

So far the official response has not been too enthusiastic, but the recent Alaskan oil strikes, as well as mineral discoveries in Canada's far north, could give fresh impetus to the scheme. Both work and transportation would be far easier—and cheaper, if the climate was improved. The Gulf Stream, the same body of water that makes sure the British Isles do not suffer the same climate as Labrador, could help turn what is now a freezing desert into a habitable place.

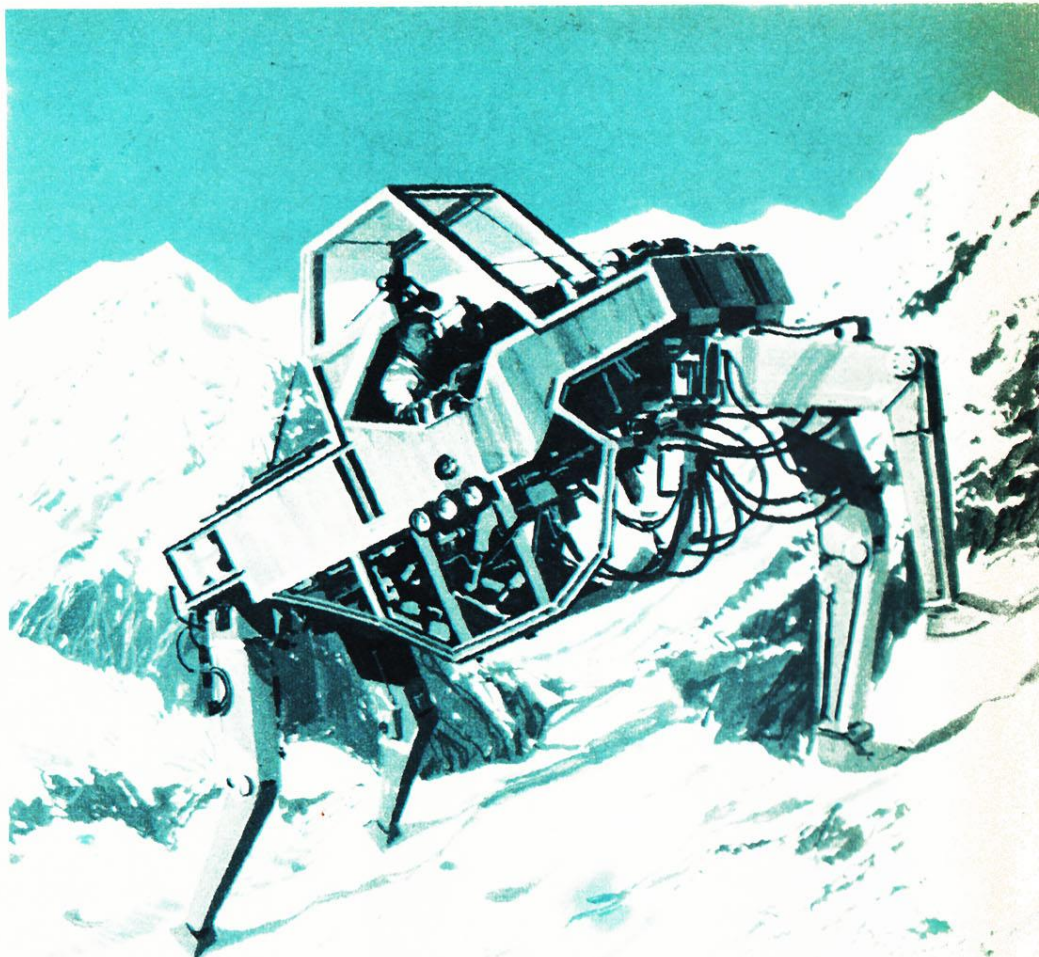
The Russians have a good reason for placing such faith in the power of the Gulf Stream. In fact they owe the existence of their one northern ice-free port, Murmansk, to another branch of it. Every other Russian port is ice-locked in winter. Some of them are useless for six months of the year.

Ever-Frozen Soil

Fighting the ice's frigid grip has, naturally, become something of an obsession with the Russians. Thousands of square miles of their country is rendered useless because of Arctic cold. In Siberia, for example, the ground never really thaws at all. Their brief, three-month summer isn't long enough to melt the earth more than two feet down.

This ground ice, permafrost as it is aptly called, means that for several hundred miles inland from the Arctic Ocean nothing can grow but stunted shrubs and mosses. At present only reindeer, caribou and musk ox can hope to survive in this bitter land, but if the ice cap disappeared, the tundra could become one huge cattle ranch.

What benefits Russia, of course, benefits her Arctic neighbours as well. Alaskan oilmen and Canadian miners would be able to work in future in the sort of climate the Earth enjoyed 4,000 to 6,000 years ago—when mammoths basked in the sun at the edge of the Arctic Ocean!



**YOU, TOO,
CAN BE
SUPERMAN!**

*Just by
using one of
these miracle machines
that multiply many
times the muscular
strength and skill of Man*

It would have made the perfect mount for a medieval knight in armour. It weighs as much as a family car, stands eleven feet high, and clanks along on four metal legs.

Meet the Mechanical Horse, a strange walking-machine invented to carry man over rough ground where other vehicles cannot go. Although it walks at the slow pace of five mph, it has

endurance that no man could possibly match.

The Mechanical Horse is designed not only to carry man, but to multiply the normal strength of the rider-operator's arms and legs. In other words, the machine can make a man into a superman!

In recent tests, the prototype horse walked across level ground, turned

around, climbed obstacles, lifted a vehicle out of a ditch, and hoisted a 500 lb. load on to a truck with one foot.

This wonderful machine is being developed in the United States for use in handling heavy materials in industry, for space and underwater research, and for transportation over rugged terrain.

The horse automatically follows the movements of the operator, who sits inside a kind of cockpit and manipulates pedals and hand-levers. The operator uses his arms and legs to direct the machine's limbs to perform tasks that would ordinarily be beyond him.

The legs of the machine are, in fact, a powerful extension of the man's own arms and legs. Through an arrangement of electronic impulses he can "feel" what the mechanical limbs are doing. This enables him to operate the machine in the dark.

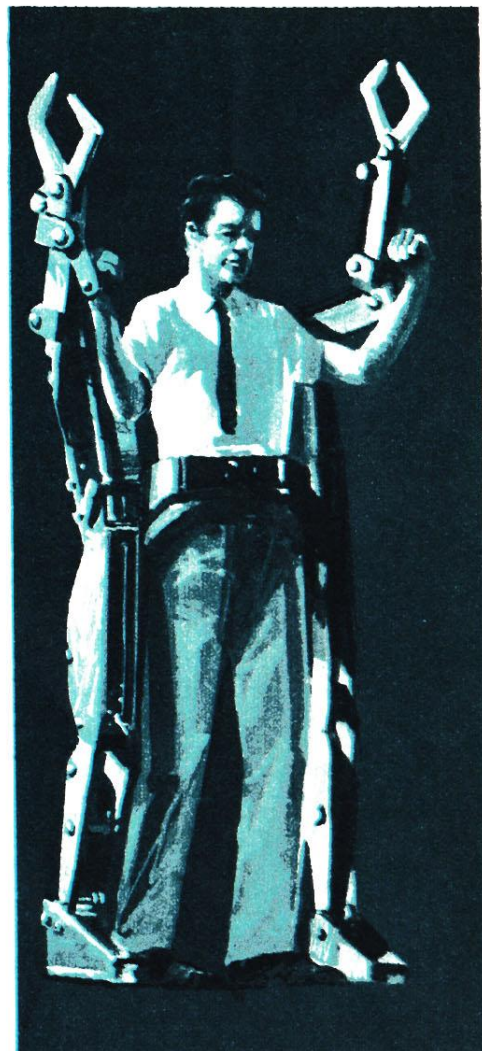
The Mechanical Horse (left) uses a hydraulic system to multiply the strength applied by its rider's limbs. The huge Pedipulator (below) can stride along at 35 mph, straddling ravines and lifting weights of over 1,000 lb.

The man "feels" the machine take the strain as it lifts heavy weights, and senses its response to other commands even though no actual physical strain is placed upon him. He reacts as he would if the physical demands were being made on his own body, but the machine takes all the strain.

Hydraulic Limbs

The strength of the horse is provided by a hydraulic system. Each leg is equipped with three motions: two in the "hip" and one in the "knee". The "muscle" of each leg is a hydraulic actuator (see *WORLD of WONDER* No. 41), driven by high-pressure oil, and changes in the quantity and pressure of the oil move the leg. The machine is driven by a petrol engine.

The Mechanical Horse is one of several machines with metal muscles that can multiply man's physical power. Another one is the huge, two-legged walking machine called the Pedipulator, that can stride along at 35 mph and step over, or straddle, small ravines and rivers. Its two long arms are capable of



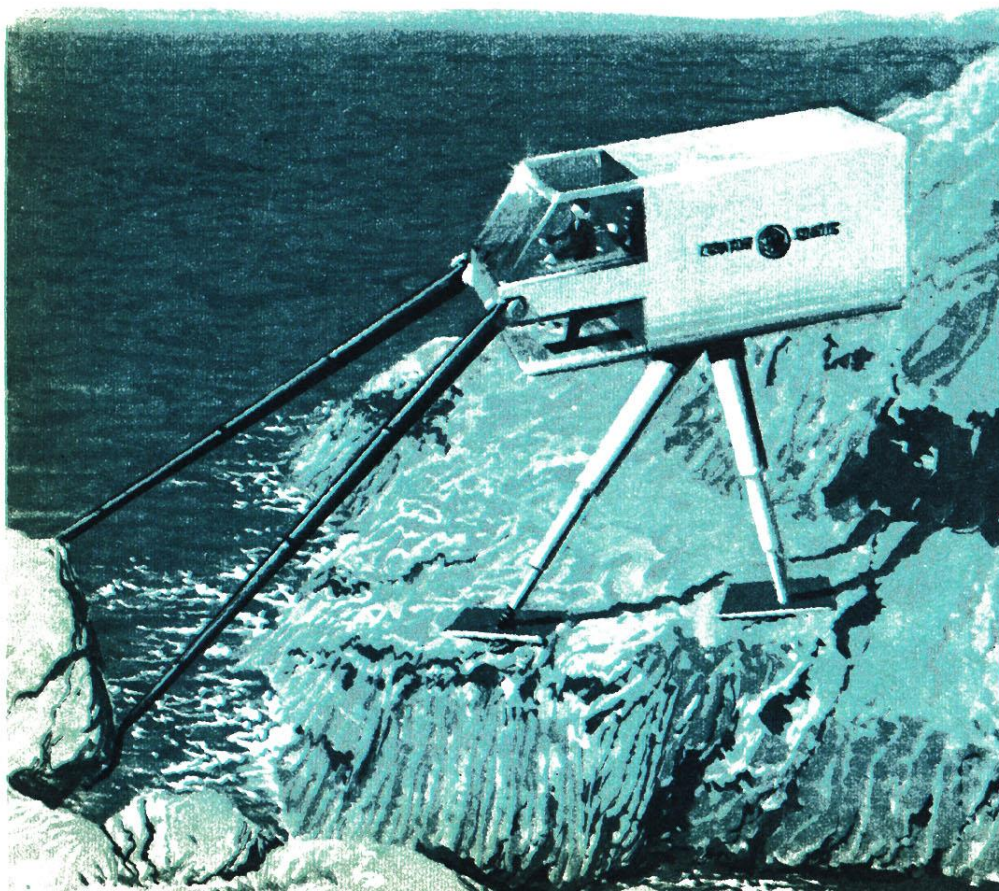
The Hardiman is a framework of mechanical muscles with which a workman will be able to lift heavy loads without exerting great force himself. The metal muscles are attached to his body, and the mechanical limbs mimic his movements.

lifting weights of over 1,000 lb. The Pedipulator is operated by a man using the same copycat-control system as in the mechanical horse.

Also under development—but on a smaller scale—is a device called the Hardiman, a framework of mechanical muscles with which a workman will be able to lift heavy loads while exerting little force himself.

The metal muscles are attached to his body, and when he moves his limbs the mechanical limbs mimic his actions. This device will enable the workman to do the job of a forklift truck.

These Man-machine muscle units are the scientific development of the primitive hand-tools which extend the limb, amplifying the power of the arm and hand. From these simple tools have come the complex machines that amplify many times the combined energies of large numbers of men.



Throughout history, there have always been men who believed that they lived in exciting, inspiring times. But no one in previous centuries has known the sort of thrill we experienced on 21st July, 1969. That day—or night, depending on where you lived—Apollo 11 astronaut Neil Armstrong became the very first man ever to step on to a planet other than his own.

Since 1969 there have been several more "Moon walks" but, of course, the Americans' Apollo flights are only the beginning of the story. If you ever manage to see a sample of Moon rock brought back by the astronauts, just think: that is the sort of material on which future cities on the Moon will be built.

For that is the next great step in Man's exploration of Space, and it may well be a fact by A.D. 2000.

As far back as 1960, the Russians were already preparing for this by constructing a Moon City in which human life could exist comfortably. This city included not only buildings, but an approach road which was

futurescope

covered in dust, just as it would be on the Moon. Cars travelling along this road would be hermetically sealed and airconditioned: if they were not, everyone in them would be roasted to death by direct radiation from the Sun.

The approach to Moon City is through a narrow gallery hewn out of rock. At the end of the gallery is an aluminium door, through which people would pass into an air-lock. When the doors behind them have closed, those in front of them open.

Creating Atmosphere

These precautions are very important indeed, because Moon City would need to have its own atmosphere, since there is no air on the Moon.

Inside the city, atmospheric pressure would be a third less than pressure on Earth

at sea level, but it would contain much more oxygen than Earth's atmosphere.

There would be, of course, a risk of the atmosphere leaking out if the city's roof were punctured by a meteorite. In order to reduce this danger, the Russians have made sure that any damage caused would be restricted to one area only. They have built walls every 800 yards or so: these act like the watertight compartments of a liner—if a meteorite plunges through the roof, the precious atmosphere would escape from one compartment only.

The roof of Moon City is made from transparent layers of glass and plastic. Carefully mixed gases between the layers ensure that only the sort of solar radiation that exists on Earth would reach the city below. Another purpose of this kind of roof is to turn solar radiation into electricity.

One very important thing for the people of Moon City would be to grow their own food, for it would be much too expensive to send food to them from Earth: sending a

continued on page 22

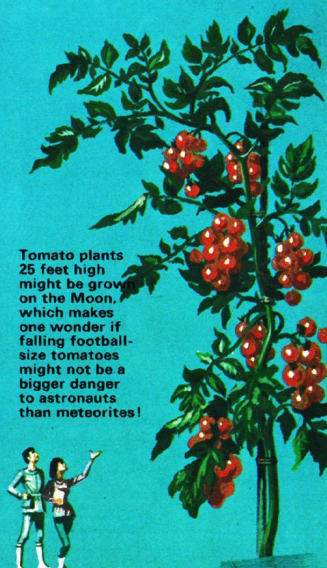
MOVING TO THE MOON

FOR SALE A large area of barren rock and dust. Ripe for development. Hot and cold climate. No running water. Bring your own air!



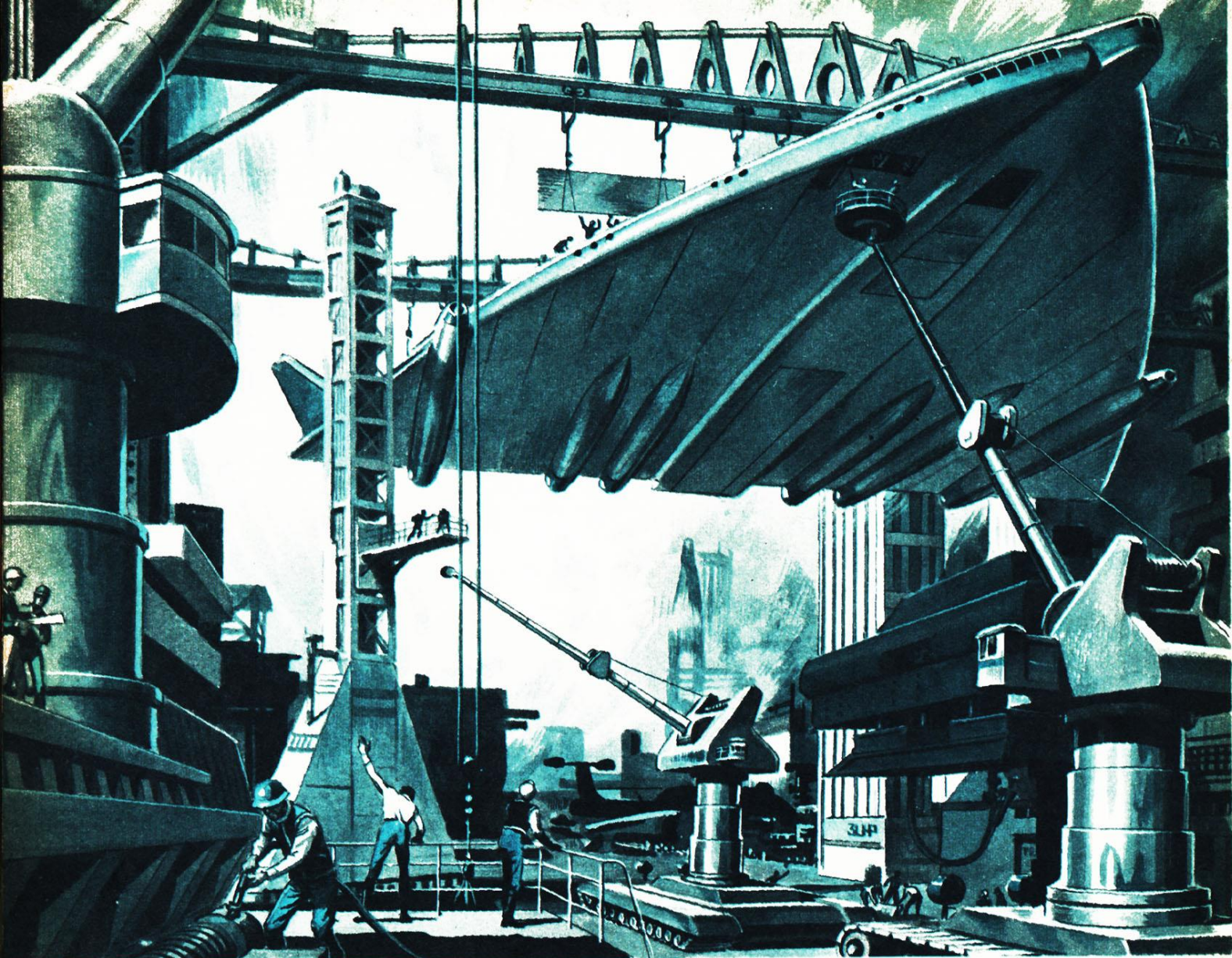
BLOOMING MOON

Taking enough food to support a Moon colony would be an expensive waste of rocket power. Instead, fresh vegetables and fruit could be grown on hydroponic or soil-less farms (see *WORLD of WONDER* No. 80) inside the lunar domes. Experiments have shown that Moon dust is extremely fertile—radishes could grow as big as palm trees and onions might have stalks 30 feet long—there'll be lots of salad days for the astronauts!



Tomato plants 25 feet high might be grown on the Moon, which makes one wonder if falling football-size tomatoes might not be a bigger danger to astronauts than meteorites!





FLY ME TO THE STARS, TO JUPITER OR MARS!

Once the lunar base has been well-established, it will be just like living on Earth for the men and women stationed there. The Moon will also act as a springboard for the huge spaceships making journeys of exploration to planets like Mars, Saturn and Jupiter, and perhaps eventually the stars.

slice of bread there, for instance, would cost its weight in gold!

Fortunately, it is possible to grow really huge vegetables on the Moon. It has been discovered that Moon dust, which is something like 3,500 million years old, can make seeds grow much faster, much larger and much greener than they do on Earth. A radish grown on the Moon would grow to the size of a palm tree, and an onion might have a stalk 30 feet long!

Moon Materials

People, soil and seeds would, however, be the only things imported from Earth. The rest of Moon City, the Russians plan, could be constructed from materials found on the Moon itself.

The glass and plastic for the roof could be made in lunar factories and here, too, Moon-dwellers would be able to build spaceships for the exploration of Space beyond the Moon.

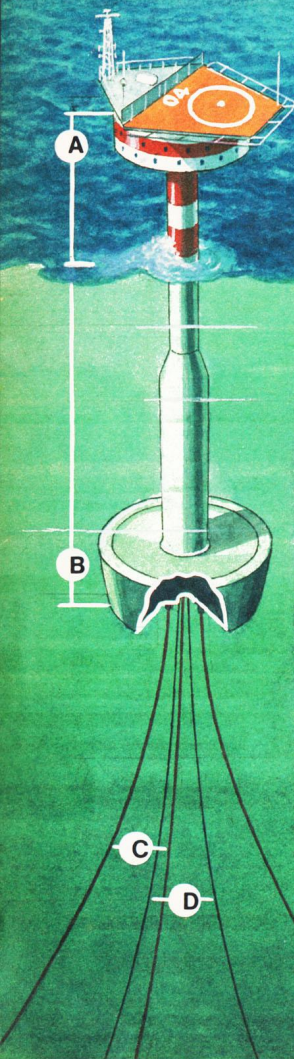
The first planet to which the Russians will probably travel from Moon City is Venus. Several Russian rockets launched from Earth in recent years have been sent to observe Venus.

While Venus 5 was on its way at the beginning of 1969, a West German space scientist said he thought the Russians intended to find out if the planet lacked oxygen. If this was so, then the Russians might send oxygen-producing bacteria to Venus so that, within a few centuries, the atmosphere could be completely changed and Man could live there.

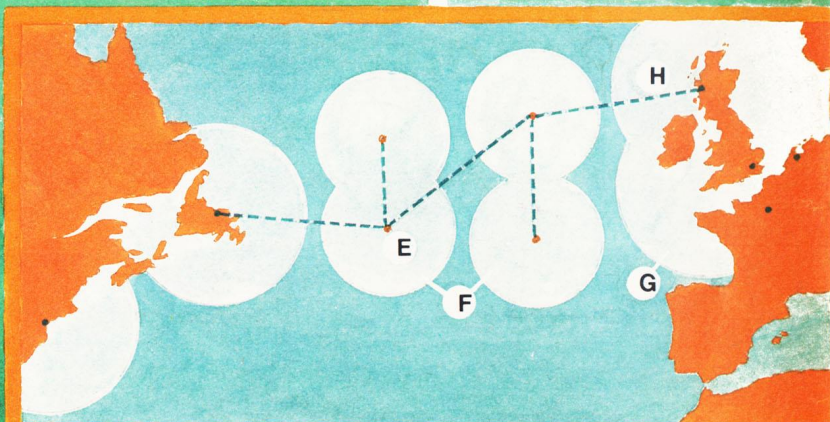
When this comes to pass, if it does, men living on Venus will not have to live in places like Moon City: they will be living more like they do on Earth, and will probably work at building launch pads for spaceships to take off for Mercury, Saturn, Uranus, Jupiter...? Take your pick: Man's natural love of adventure will, in the future, make each planet in our Solar System just one more stop on the way to the stars.



Beyond the year AD 2000 journeys to other planets could become almost commonplace. Imagine going to Mars instead of Majorca for your holidays!



Each ocean platform is moored to the sea bed and floats vertically because of its greater submerged portion. (A) Superstructure 90 feet above sea level. (B) Buoyancy tank 210 feet below sea level. (C) Mooring cables down to 10,000 feet. (D) Submarine telephone cables.



VITAL LINKS FOR AIR SAFETY

These are the proposed positions of the four ocean platforms in the North Atlantic, linked by submarine cable to the shore and giving radio and radar coverage to aircraft flights between Europe and America. (E) Ocean platforms. (F) Extent of radio coverage. (G) Extent of land-based radio control. (H) Proposed submarine telephone cable.

Owing to the curvature of the Earth's surface, radio contact with aircraft flying over very wide oceans becomes more difficult as the aircraft gets out of range of its land-based control centres. At peak periods, as many as 100 aircraft may be packed into a 500-mile-wide flight path over the North Atlantic radio "blank" spot, so you can see that just when safety in the air is most needed communications become unreliable.

As a solution to the Atlantic air-traffic control problem it is planned to launch four sea stations in the "blank" area. Each will be linked by radar and radio to aircraft on Trans-Atlantic flights and will be able to relay information to and from shore-based control centres by submarine telephone cables.

Ships will also benefit by radio contact with the sea stations which will also provide an excellent base for weather reports.

The floating platforms will be moored 600 to 700 miles apart in mid-ocean. Each one will consist of a tubular structure about 400 feet long and 16 feet in diameter, floating in the sea with its greater length below the surface.

The superstructure will be 90 feet above the waves, 80 feet in diameter and 30 feet high. This will house a crew of 12 men and all the necessary radar and radio equipment. The flat upper deck will be used as a landing platform for relief helicopters.

The bottom end of the tube will be moored by three cables and here also will be the connections for the submarine cables. Experts estimate that the average rise and fall of the sea station will not exceed six inches and even in extreme weather conditions, and conditions in the Atlantic can be fearful, life will never be uncomfortable aboard these "safety islands in the sea".

SAFETY ISLANDS IN THE SEA

We all have our "blank" spots—and so does the Atlantic Ocean. Here radio contact with aircraft becomes unreliable, and to ensure future air safety it is planned to launch floating radio stations



1. Submarine telephone cable trunk to communications room.
2. Fuel tanks for gas turbine power system.
3. Telephone relay and equipment room.
4. Safety nets.
5. Helicopter landing platform.
6. Crew relief and supplies helicopter from supply ship.
7. Main communications room.
8. Single cabins for crew—12 in all.
9. Kitchen.
10. Crew recreation room.
11. Workshops.
12. Mess room.
13. Power supply room—gas turbine driven generators.
14. Marine radio aerial.
15. Aircraft communications aerial.

Hydrofoil ships are already fact—and not so far away are the really super sea-skimmers, giant hydrofoil liners that will ride up on sturdy “sea legs” and whisk 1,000 passengers across the Atlantic at 250 mph!

SHIPS WHICH GET UP AND GO!

It is eight o'clock one bright morning in the future. We are among the thousand passengers boarding the super streamlined *Atlantic Express* at the British port of Southampton.

The sun sparkles on the white-painted aluminium liner. We are bound for the United States aboard the jet-powered hydrofoil craft that will skim over the ocean at 250 mph and reach New York in just twelve hours!

This may seem a fantasy view of the future, but the super sea-skimmers are nearer than you think. The use and development of hydrofoil craft today is paving the way for the giant *Atlantic Express* of tomorrow.

What exactly is a hydrofoil craft? It is really a ship with “skis”, or hydrofoils, that raise the hull above the water to reduce the

drag of the water. Hydrofoil craft are built for speed and stability.

Much of the power of conventional boats and ships is wasted in pushing water aside (making waves) and in overcoming the frictional drag of water against the hull. Even the hovercraft, which moves over the water on a cushion of air, creates a trough, with a wave around it, and wastes power by having to “push” this wave ahead of it.

A hydrofoil craft does not waste power in this way. A hydrofoil (so called because its skis resemble the aerofoil, or wing of an aircraft) develops lift in much the same manner as an aircraft wing but, of course, it is water and not air which is flowing over the wing.

With sufficient forward speed, the lift generated is great enough to raise the boat

FutureScope

All aboard the *Atlantic Express*! An artist's impression of a giant hydrofoil liner embarking passengers at Southampton for the twelve-hour journey across the Atlantic to New York. Already the Russians operate hydrofoils which can carry 300 passengers and travel at over 50mph.



SHIPS WHICH GET UP AND GO!

hull clear of the water. In this condition, the boat is said to be "flying" in the water. And since the hull is raised clear of the water, wave-making and frictional drag are almost eliminated.

Because of its smooth-riding performance the hydrofoil craft prevents seasickness. A conventional vessel can be compared to an airship which, moving slowly through the air, is constantly at the mercy of the air waves buffeting against its hull. It is this rolling and pitching that brings on seasickness. The hydrofoil does not rock and roll; the faster the speed the smoother the ride.

Hydrofoil craft are already an international means of transport. They are in operation all over the world: in Italy, Switzerland, Germany, Poland, and the Scandinavian countries; in Canada, Hong

Super sea-skimmers—the revolutionary design

Kong, Japan, the United States; and in many South American countries. Most of the craft are on regular ferry service on large lakes, rivers, and from island to mainland.

The development of the hydrofoil has also been international. Like many modern ideas, the hydrofoil is not really new. The idea was originated about a century ago. But it was an Italian, Enrico Forlanini, who came up with the first successful hydrofoil in 1905 when he "flew" over Lake Maggiore at 40 mph in a boat fitted with airlift-type foils.

German Naval Craft

In the United States Alexander Graham Bell, pioneer of the telephone, built a successful hydrofoil boat in 1919 that reached 70 mph, setting a world record for all water-borne craft of the time. Then Germany took a hand. Baron von Schertel began designing hydrofoils for the German Navy. This led to the Schertel-Sachsenberg hydrofoil system

that provides two foils in tandem arrangement, one under the bow and the other under the stern.

Great Britain, France, Switzerland, and the United States were also involved in the modern development of the hydrofoil, but it was the Italians who first built successful passenger hydrofoils for commercial use.

Ferry Service

In 1954 the Rodriguez shipyard at Messina obtained the licence for building boats with the Schertel-Sachsenberg foil system. And so the very first passenger-carrying hydrofoil boat was launched in 1956; called the *Freccia del Sole* (Arrow of the Sun), it seated 72 people and was put into ferry service across the Strait of Messina that separates Italy from Sicily.

It was a great success. The high-riding hydrofoil cut the rough, eight-mile journey from an hour to a smooth 15 minutes! Today, Rodriguez hydrofoil craft are in service all over the world.

Russia, a vast land of great lakes and rivers, has a widely-developed hydrofoil

that is riding on the crest of a wave!

transport system, with over a hundred craft running regular services. The Russians build big hydrofoils; the "Sputnik" type is over 150 feet long and carries 300 passengers at a top speed of 50 mph.

The Americans are also thinking big. They are developing plans for a 500-ton hydrofoil ocean liner capable of carrying 500 passengers at 100 mph. So you can see that the 250 mph *Atlantic Express* is not far off.

With the hydrofoil liner will also come the hydrofoil cargo vessel. Its great speed will enable it to carry perishable goods without refrigeration. Another useful function will be to bring back fresh fish from trawling grounds. Nearing a port, giant helicopters could land on the cargo-hydrofoil's deck pad and lift off urgent goods and mail, thus saving time in docking.



High speed fruit and fish! Above: Hydrofoil cargo ships will be able to sail from port to port so quickly that it will make it unnecessary to carry perishable foods like meat, fish and fruit in refrigerated cargo holds. As the hydrofoil nears port, container-carrying helicopters could airlift urgent mail and goods from the deck and speed them on their way. Below: Passengers aboard the *Atlantic Express* will be able to leave their sea-sick pills at home! As the forward speed of the hydrofoil increases, its underwater "wings" or foils lift the hull clear of the wave tops and this stops pitching and rolling—the cause of sea-sickness aboard ordinary ships.



ICEBERGS in your WATER TAP

You know," said Professor Sinclair as he turned off the dripping tap in his kitchen and looked at his schoolboy son, "it's amazing the amount of water we waste."

"People seem to think," went on the professor, "that because we get water just by turning on a tap there is plenty of it and our taps will never run dry. But the world is running short of water while millions of gallons are being lost every day from millions of dripping taps."

"But I thought that deserts were the only places where water is scarce," asked the professor's son Timothy.

"That's just where so many people are wrong," replied the professor. "There are countries with rivers and lakes fed by regular rainfall which are becoming very hard-pressed indeed to get enough water for their farms, fac-

Scientists see the day when mountains of frozen water will be towed from Antarctic Seas to supply the world's thirsty lands

tories and households. And every day the world's population is increasing, so that more and more water is needed."

"Is science doing anything to get us more water?" asked Timothy.

"A very great deal," answered his father. "Huge plants are in operation distilling or extracting fresh water from seawater, but that is very expen-

futurescope

sive. Some American scientists believe it would be cheaper to tow icebergs from the Antarctic and use them to help our water supplies. As you know, Timothy, icebergs are really floating mountains of fresh water."

"Tell me some more about our water supplies," asked Timothy. "My form master has told us he wants us to write an essay on that subject."

So Professor Sinclair gave Timothy a little lecture on water supplies and how icebergs could help to increase them.

Insatiable Thirst

Only a small proportion of the fresh water used in the world is for drinking, cooking and washing. Most of it is needed to quench the insatiable thirst of agriculture and industry.

A field of grain soaks up 1,000 gallons of water to provide one loaf of bread, and it needs 4,000 gallons to produce one pound of beef or mutton.

Just over 60,000 gallons are used in the various processes that produce a ton of steel, and ten times that quantity goes into the production of a ton of artificial rubber. The aluminium, coal



Millions of gallons of water in one monstrous lump! In this vision of the future an fantastic voyage from Antarctica to California

and plastics industries use equally fantastic amounts of water.

America is one of the countries where the shortage of water is becoming a serious problem. Every day of the year the USA uses 350,000 million gallons for its homes, factories and farms.

Even that flood is not enough. Some parts of the country, particularly the western states and along the Pacific coast, have never had sufficient water.

Fifteen years from now, America will be using at least 500,000 million gallons a day. According to the experts, that is about as much as could be got from rivers, lakes and other natural sources.

There is one unlimited source of water for any country with a coastline —the sea. But before seawater can be used the salt must be extracted or taken from it.

Atomic Distilling

Throughout the world there are about 30 huge plants distilling seawater. Some of them use the heat from atomic energy to boil the seawater and so produce steam. When the steam is cooled it becomes fresh water and the salt is left behind.

One of the biggest of these distilling plants in the world is at Freeport in Texas. It sucks up salt water from the Gulf of Mexico and delivers it as fresh as spring water.

Unfortunately distilling seawater to solve the problem of fresh water supplies is very expensive. It can cost any-

thing from 18p to 70p a thousand gallons.

No wonder water authorities are thinking of the millions upon millions of gallons of fresh water locked in the vast icebergs which every year are breaking away from the Antarctic continent to float out to sea. In fact, scientists at the University of California Institute of Oceanography have already worked out plans to bring icebergs from the Antarctic to California, where water shortage is fast becoming a serious problem.

Icebergs ten miles long, a mile wide and towering 250 feet above the sea are common in the Antarctic. When we remember that there is nine times as much of an iceberg under the sea as above it, the floating mountains of ice contain a colossal amount of water.

Marine engineers have calculated that three ocean-going tugs could easily tow the biggest of icebergs from the Antarctic to the coast of California. The icebergs would first be towed into the Humboldt Current, which flows off the west coast of South America to a point off Ecuador. From there the icebergs would be guided by the tugs into other currents which would take them in a long loop nearly to Hawaii and thence to a point near Los Angeles.

By taking full advantage of favourable ocean currents, very little actual

towing would be needed. The chief task of the tugs would be to tow the icebergs into the right currents. The voyage from Antarctica to the coast of California would take about a year.

To prevent the icebergs from melting away during their long voyage through the warmer seas, they would be sprayed with a harmless plastic coating which would act as an insulator to keep the iceberg frozen. The coating would be sprayed on by helicopters at intervals throughout the journey. This plastic coating would dissolve away in time and spraying would stop shortly before the icebergs reached their destination.

Millions of Gallons

Even if half an iceberg melted away during the voyage, millions of gallons of frozen but fresh water would be left.

Arriving off the Californian coast, the icebergs would be grounded in shallow water and surrounded by a rubber barrier shaped like an enormous sausage and inflated with air. The seawater inside the barrier would then be pumped out and the icebergs allowed to melt.

As the icebergs melted, the fresh water from them would be pumped to reservoirs and then distributed in the ordinary way to farms, factories and

iceberg commences its

houses. It has been estimated that one iceberg contains enough water to supply the city of Los Angeles for a month.

According to calculations, the total cost of bringing a large iceberg from the Antarctic to the California coast, spraying it and building the rubber barrier around it would be about £400,000. This means that the fresh water obtained from the iceberg would be about one new penny a thousand gallons. That is only a fraction of what Los Angeles now pays for its water.



IT CAN TAKE YOU TO THE STARS

So powerful is the world's biggest telescope that with it you could read the name on a ship 3,000 miles away

On the top of Mount Palomar, 6,125 feet above sea-level in California, USA, stands the world's largest telescope and observatory.

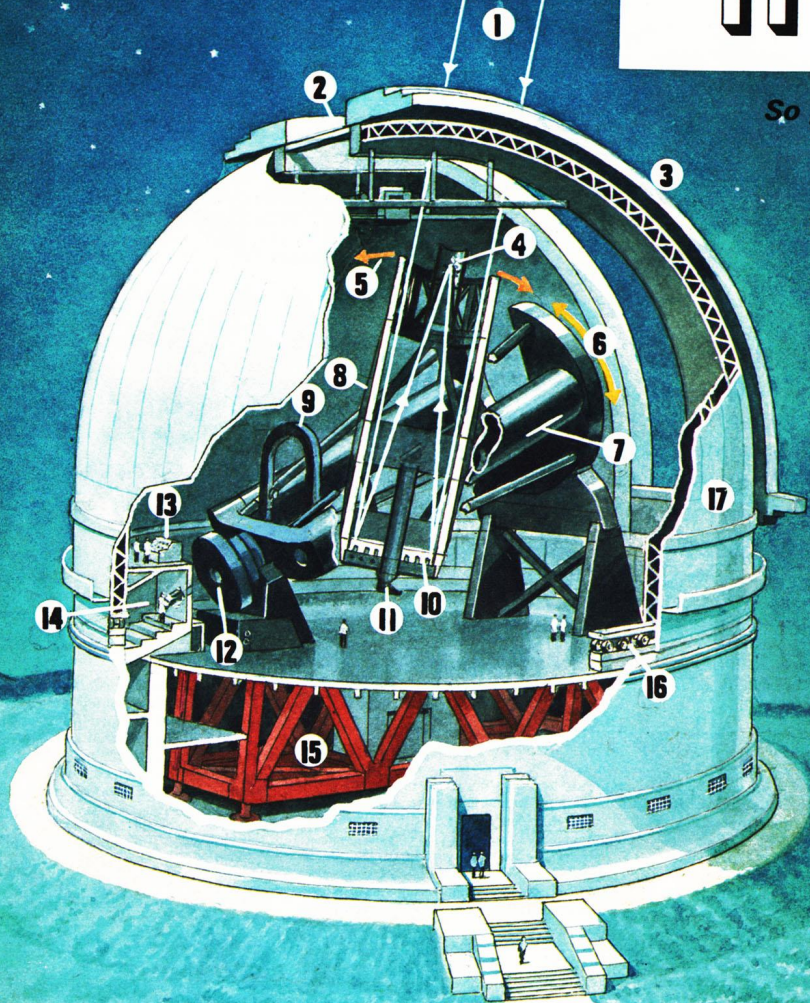
The telescope, with its huge 200-inch diameter reflecting mirror magnifying 1,000,000 times, makes the Moon seem only 25 miles away, and if the earth were flat observers in London would be able to read the name of the liner Queen Elizabeth II as she steamed into New York, 3,000 miles away.

The telescope tube and its massive mounting weighs nearly 500 tons; yet it must be constantly on the move while observations are being made, keeping "in step" with the

slowly swinging heavens. Powerful but delicate electrical apparatus, controlled by a master clock, keeps the tube trained steadily on the distant stars.

Nearly all modern astronomy is done by photographs, and here lies one of the most astounding things about the giant telescope. Using very long exposures, sometimes running to 24 hours, astronomers can now study pictures, free from blurring, of thousands of new stars that before were invisible.

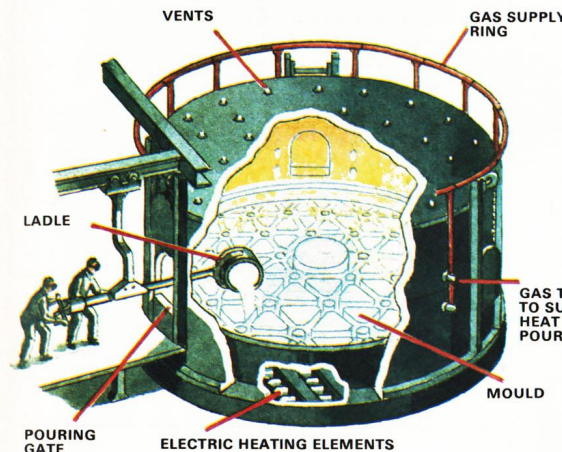
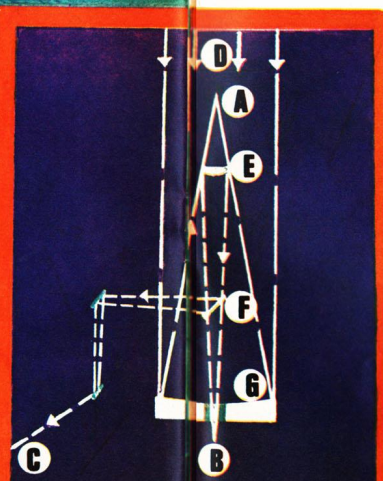
The giant telescope, which took twelve years to complete, deserves beyond doubt to rank as one of the modern wonders of the world.



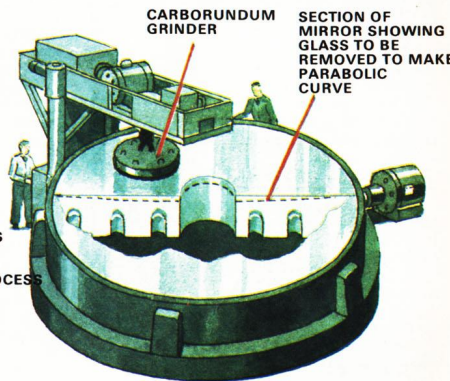
KEY TO THE PICTURE ABOVE

1. Light rays from Moon or star.
2. Opening in dome—30 feet wide.
3. Sliding shutters for closing opening in dome.
4. Observer's cylinder and Prime Focus of telescope.
5. Elevating and lowering movement of telescope tube.
6. East-West movement.
7. North bearing.
8. Telescope tube assembly.
9. Auxiliary mirror for different observations.
10. 200-inch mirror.
11. Lower observation position—called Cassegrain Focus.
12. Opening for photographic work—called Coudé Focus.
13. Control panel for all telescope movements.
14. Spectrographic chamber (for study of the spectrum).
15. Support for the 500-ton telescope and mounting.
16. Revolving dome wheels.
17. Revolving dome—137 feet in diameter.

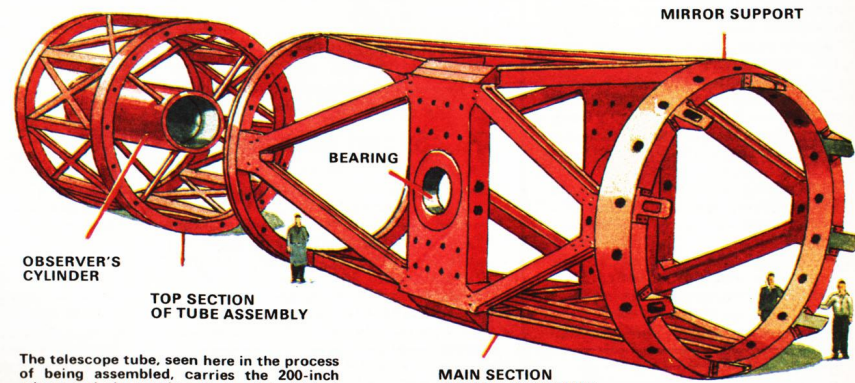
The diagram on the right shows the three different systems of focus—only one being used at one time. A. Prime Focus. B. Cassegrain Focus. C. Coudé Focus. D. Moon or starlight. E-F. Removable mirrors. G. 200-inch reflecting mirror.



Pouring the molten glass into the mould of the 200-inch mirror. Oven temperature: 1,510° centigrade. The mirror was then cooled in an annealing oven.



Rough-grinding the 20-ton mirror. To make the curve in the mirror, 4½ tons of glass was removed. The mirror was then polished to an accuracy of 1/1,000,000 of an inch.



The telescope tube, seen here in the process of being assembled, carries the 200-inch mirror and observer's cylinder. It is 60 feet long, 22 feet in diameter and weighs 125 tons.

MAIN SECTION OF TUBE ASSEMBLY

WORLD of WONDER

Incorporating TREASURE

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Turn to page 3 and read about the
HOUSES OF TOMORROW



A tall, white, modular building under construction. The building is composed of many small, rectangular units stacked on top of each other. A crane is visible at the top, and a small platform is suspended from it. The background is a bright blue sky with some clouds. The overall style is futuristic and architectural.

UP SHE GOES!

Someday we
may live in
houses like
stacked
caravans,
flying saucers,
or even in
transparent
domes

What kind of houses will people be living in tomorrow? That is a question which architects and builders are busily trying to answer with lots of surprising ideas.

Houses are generally built to last for a hundred years or more, so that most people of this and the next generation will still be living in houses that are standing today. But new houses built in the future are likely to be very different from those now standing. In fact some new-look houses are already built and people are living in them.

Among the latest ideas in housing are caravans which can be either towed by the family car or stacked one on top of the other to form blocks of flats.

futurescope



This could be our "Chez-Nous" or "Dun Roamin" of the future... a house shaped like a flying saucer. Just join two fibre glass bowls together, put them on stilts... and there you are. Inside? As you can see it's all Mod. Con.

Each of the caravan-flats is in the shape of an oblong box. It can be made of aluminium, plastic or a special lightweight reinforced concrete, with the inside of the box divided into living room, bedroom, bathroom, toilet and kitchen. Electric cables for heating, lighting and cooking, and the pipes for water are led to one end of the box, in front of which is a small balcony. On the top and bottom of the boxes are slots, so that two or more caravan flats can be locked together.

When used as a caravan, the flat is mounted on a four-wheeled trailer which can be towed by a car. If the owner wants to stay in a town, all he has to do is to tow the caravan to an existing stacking site.

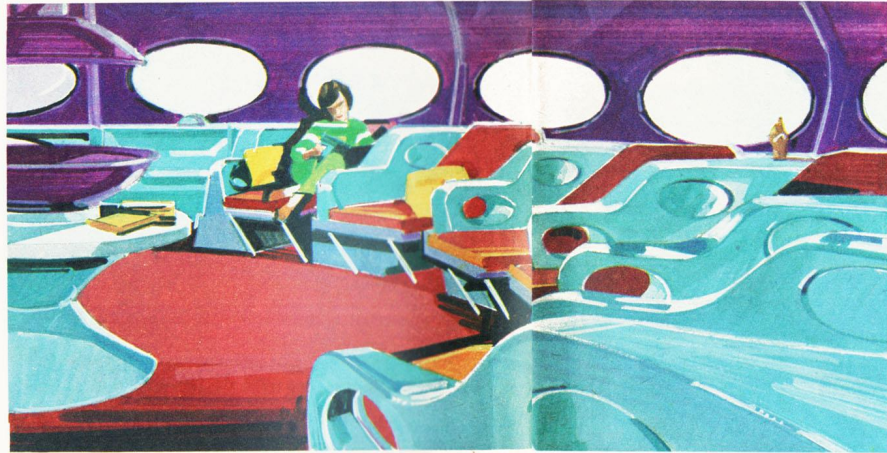
In the centre of the location is a concrete tower up which run power cables and a water main, each floor level being equipped with electric plugging-in points and water taps.

Easily Moved

A crane lifts the caravan off its trailer and swings it into position round the tower. When the caravan has been stacked, its electric cables and the water pipes are connected to the cables and pipes in the tower. Thus, when the owner of a flat has to move or is going on holiday, his flat is lifted by the crane on to the trailer and becomes a caravan again.

Because the flat is light in weight and easily disconnected from the tower, it is not difficult to take out a flat, even at the bottom of the tower.

Another idea is to build a steel framework round the tower. Each floor



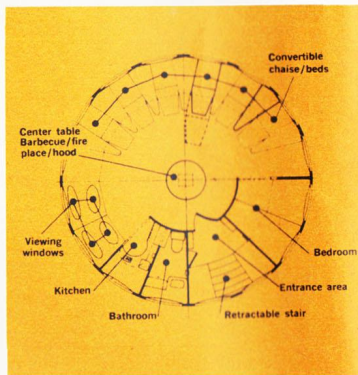
of the framework would be divided into spaces with wheeled trolleys which could be pushed in or out like drawers. In this way the caravan-flats could be taken in or out of the stack without disturbing the others, something like putting books in a bookcase.

One Scandinavian architect thinks the Space Age should have space-age houses. So his design for the house of the future reminds us of a flying saucer. It is made from fibre-glass in the shape of two round shallow bowls joined rim to rim, 26 feet 9 inches (800 centimetres) in diameter and 12 feet 9 inches (390 centimetres) high at the centre. It stands on a stainless-steel trellis foundation which raises it 3 feet 3 inches (100 centimetres) above the level of the ground.

This dwelling has completely built-in furniture arranged around the sides, with comfortable couches which can be extended to form into beds. In the centre is a stove for cooking and heating with a chimney leading through the roof.

As it is made from fibre-glass which is coloured during the mixing of the materials, the house never needs painting. Weighing only two tons it can be lifted by crane on to a truck for moving to a new site, or can be carried by a helicopter.

Another home of the future which is already occupied in some parts of the United States is the Instant Plastic House. Measuring 23 feet by 18 feet, it is made up of a dozen parts which two men can put together in two hours to make the complete home. The parts are delivered fitted with electric light and power points, and basins and water



Interior plan of the Flying Saucer house. Note the built-in furniture arranged round the circumference.



Centrally placed is a stove for cooking and heating, the chimney leading up through the roof.

taps ready for connecting to the main supply.

Erection begins with the floor section. This consists of a sheet of thick plastic mounted on a heavy timber frame. Along the sides are strips of thick plastic with the inner edges cut out to form serrations or teeth like those of a saw.

Along the bottoms of the floor sections the plastic is turned outwards to form a flange or lip, which is also serrated or toothed. The teeth on the wall flanges then fit into the spaces between the teeth on the floor flanges, locking walls and floor firmly together. The joint is further strengthened by heavy screws passed through the wall teeth and into the wood foundation of the floor.

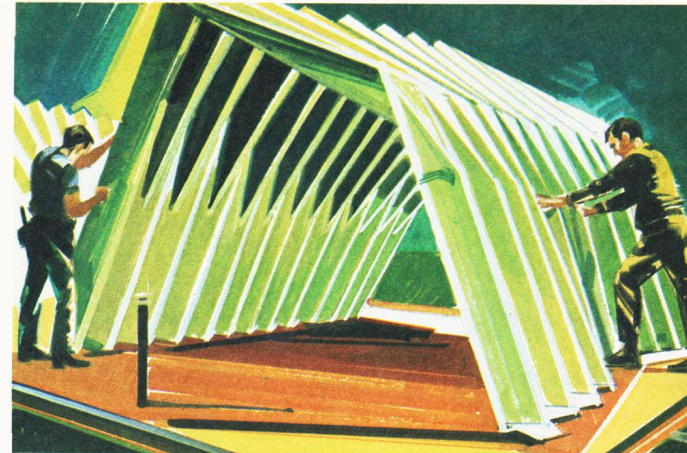
Watertight House

Each of the side sections curves over to form half of the roof, so that when the two side walls have been erected the roof is complete. The join where the two halves of the roof meet is covered with right-angled strips of plastic which are screwed to the two halves of the roof to make it water-tight.

The ends of the house are each single sheets of plastic shaped to slot into the walls and roof, the front wall containing the house door, the rear wall being supplied with a large picture window across its width.

Sides and roof of the instant plastic house are corrugated to give it greater strength and to keep it rigid when the wind is blowing. Tests have proved that the house is watertight in the heaviest rainstorm and can withstand the fiercest of winter gales.

Buckmaster Fuller, an American architect, believes that the house of the future will begin as a skeleton of



Above—Construction begins on the Instant Plastic house. Number of parts required... twelve. Time taken by a couple of men... two hours!

aluminium strips, criss-crossed in such a way that they form a rigid net. When completed, the aluminium net looks rather like a loosely-woven basket. The skeleton is in the shape of a dome which is covered with either thin aluminium sheeting or transparent plastic. Dwellings of this type can be of any size and divided into as many rooms as required.

All the parts of Fuller's dome-house are made in a factory and then put together on the building site like a model engineering constructor set: already this system has been used for building halls, sports arenas, aircraft

hangars and community centres. Two such buildings in the U.S.A. are 120 yards in diameter, their inside area eight times more than that of Saint Peter's in Rome.

Finally, there is the air-supported house. The framework is made of rubber or plastic tubing into which air has been pumped at high pressure. The framework is then covered with plastic or aluminium sheeting, an idea that has already been tried out for all-weather tents.

A question which may well be asked is: Will these "houses of the future" be really pleasant to live in? This is largely a matter of what we are used to—and what we can get used to. There will always be people who express a preference for "traditional" houses, but even traditions change—and the novel homes we have been looking at will one day appear quite normal.

Below—Another dream house of the future, a skeletal-shaped dome covered with thin aluminium or transparent plastic.





TAKING THE TEN-THIRTY FOR TOKYO

Railway engineers who are looking into the future foresee the day when it will be possible to travel round the world from London to Tokyo by train. If that dream comes true, you will be able to get on a train anywhere in Britain and make a journey of 11,000 miles without once leaving your coach.

Not so very long ago the idea of a railway journey like that would have been thought of as just another fantasy of science fiction. But with the prospect of a tunnel being built under the Channel to link England with France, London to Tokyo by train can no longer be dismissed as a drawing-board dream.

Travelling from London to Tokyo without once having to board a ship or fly in an airliner would need the building of two tunnels and a bridge. Each would be a tremendous engineering achievement, but none would mean problems which could not be overcome by engineers if they were given the money and equipment to do the job.

Plans have been completed for Tunnel Number One, that under the English Channel, and engineers are only waiting for the

From Britain to Japan without leaving your carriage—that's the journey railway engineers are planning to offer you in years to come

signal to start work. The bridge would be across the Strait of Gibraltar, and Tunnel Number Two would be below the seabed between Pusan in Korea and Shimonoseki on the Japanese main island of Honshu. Plans for both these undertakings are on the drawing-board, though they are not as advanced as those for the Channel Tunnel.

Coming out of the French exit of the

futurescope

Channel Tunnel, the train for Tokyo would run on the French and Spanish railway lines to Gibraltar. From there the train would cross the Strait of Gibraltar to Africa by a bridge.

Spanish engineers who are studying the project believe that a bridge across the Strait will be cheaper and easier to build than a tunnel bored under it.

Underwater "Islands"

Although the Strait of Gibraltar is less than nine miles wide at its narrowest point, the water is in places 3,000 feet deep. Even a tunnel following a line where the seabed is closest to the surface of the water would have to be bored at a depth of 1,600 feet, and it would have to follow such a winding course that it would be at least 30 miles long.

Another reason for favouring a bridge across the Strait is that there are several underwater "islands" which could be used for part of the route.

The problem of erecting bridge piers in deep water would be solved by building the

piers inside enormous steel boxes, which would be floated out to the sites on pontoons. The piers would then be sunk in position.

Including its approaches on the European and African sides, the Gibraltar bridge would be 15 miles long. Its height of 200 feet above the water would allow the biggest ships to pass under it on their voyages between the Atlantic and the Mediterranean.

The bridge is planned to be 100 feet wide, with a four-lane motorway down the centre and railway tracks on each side. According to the experts, a Gibraltar-Africa bridge could be started and completed during the next ten years.

On Existing Lines

Travelling to Tokyo by way of the Gibraltar Bridge would mean building a number of new railway lines in the Middle East and in Asia including a direct line from Abadan to Peking. This would add greatly to the cost of the whole project.

Many railway engineers are convinced that it would be both cheaper and quicker for the Tokyo-bound trains leaving the English Channel Tunnel to run along the existing railway systems of Europe, Russia and China and then down Korea to Pusan.

It is 75 miles by sea from Pusan to Shimonoseki, and a tunnel under the water to join these two places would have to be 80 miles long to allow for the sloping entrances and exits. Surveys made by Japanese and American engineers prove that most of the seabed through which the tunnel would have to be bored consists of hard clay.

This means that cutting the tunnel would be comparatively easy, and it could be built in the same way and with the same kind of equipment as is used for boring London's underground railways.

Actual boring will be by a giant revolving "shovel" which will dig out the clay. The tunnel will then be lined with steel.

It was originally suggested that roads to carry motor traffic should be laid through the tunnels between England and France and Korea and Japan. Experiments have proved, however, that it would be impossible to keep the air in the tunnels fresh if they were used by motor traffic.

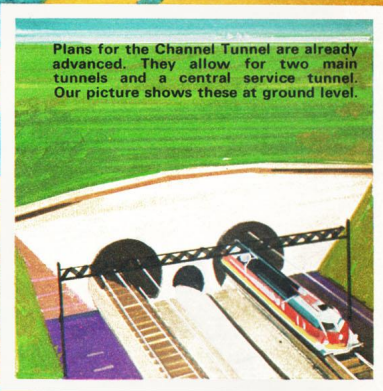
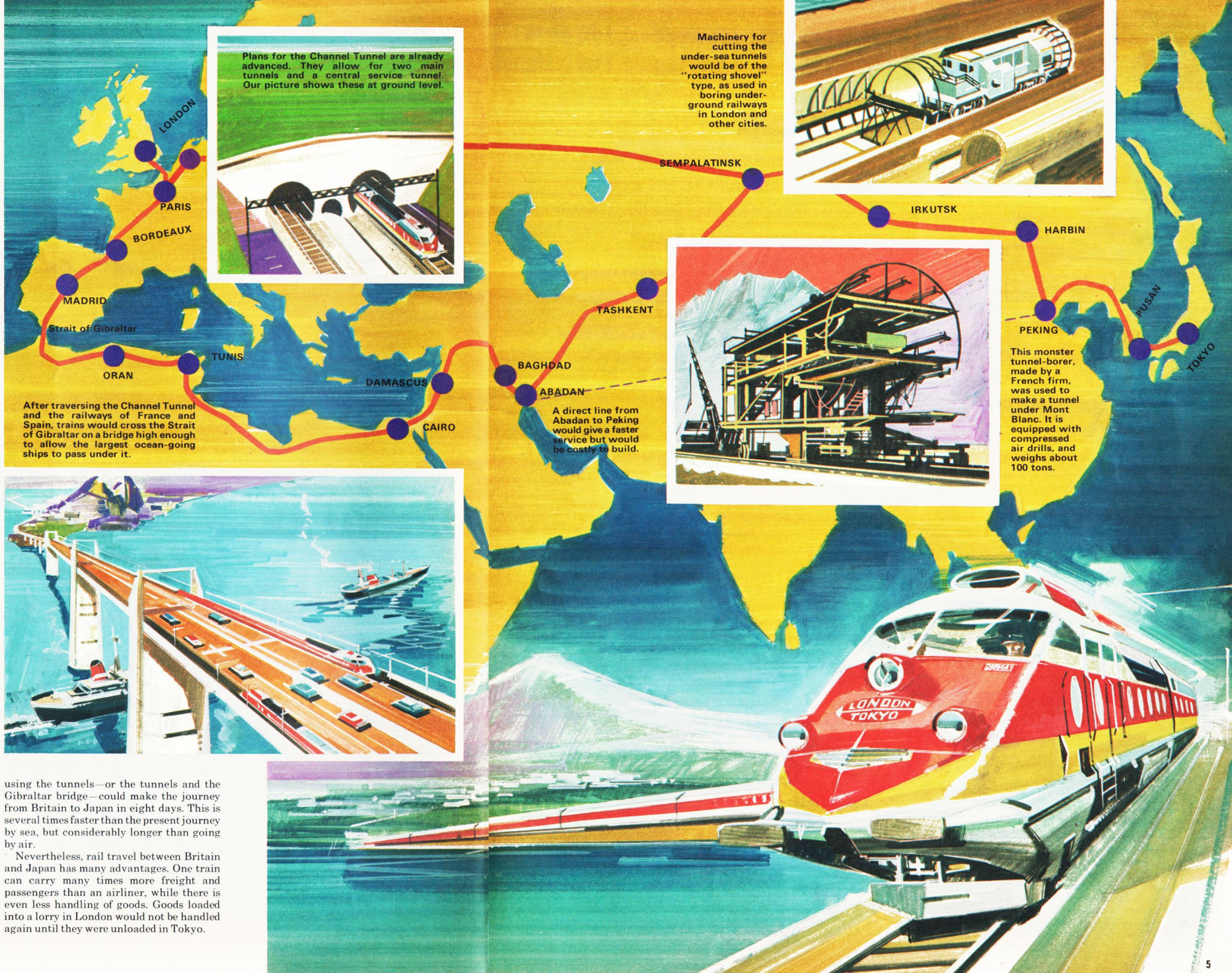
Fresh-Air Tunnels

Motor vehicles give off a lot of poisonous fumes, and ventilating shafts reaching to many feet above the sea would have to be built to carry bad air from the tunnels. Not only would the shafts add greatly to the cost of the tunnels, but in stormy weather there would be a danger of waves breaking over the ventilating shafts and flooding into the tunnels.

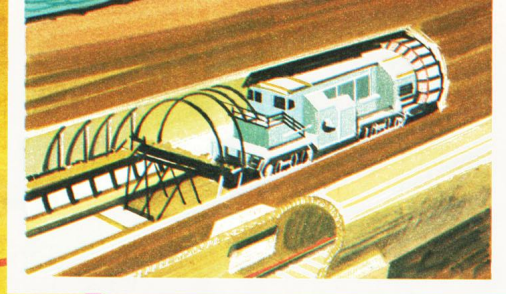
Accordingly, it has been decided that in the event of the tunnels being built all travel through them will be by electric trains, which do not give off fumes. The movement of the trains through the tunnel will circulate the air and keep it fresh.

Trains using the tunnels will have special wagons for carrying cars, vans, lorries and coaches.

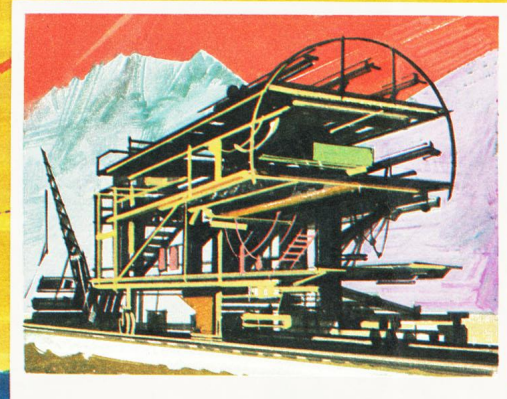
It has been estimated that express trains



Plans for the Channel Tunnel are already advanced. They allow for two main tunnels and a central service tunnel. Our picture shows these at ground level.



Machinery for cutting the under-sea tunnels would be of the "rotating shovel" type, as used in boring underground railways in London and other cities.



This monster tunnel-borer, made by a French firm, was used to make a tunnel under Mont Blanc. It is equipped with compressed air drills, and weighs about 100 tons.



After traversing the Channel Tunnel and the railways of France and Spain, trains would cross the Strait of Gibraltar on a bridge high enough to allow the largest ocean-going ships to pass under it.

A direct line from Abadan to Peking would give a faster service but would be costly to build.

using the tunnels—or the tunnels and the Gibraltar bridge—could make the journey from Britain to Japan in eight days. This is several times faster than the present journey by sea, but considerably longer than going by air.

Nevertheless, rail travel between Britain and Japan has many advantages. One train can carry many times more freight and passengers than an airliner, while there is even less handling of goods. Goods loaded into a lorry in London would not be handled again until they were unloaded in Tokyo.



futurescope

Switch on for your daily dose of learning! Already the classroom revolution of the electronic age is on its way

The classroom is large and quiet. Children, wearing earphones, sit at desks and operate silent electronic machines.

Some of the youngsters are pushing the buttons of a Talking Page, some are tapping the noiseless keys of a Talking Typewriter, and others are viewing moving pictures on a small desk-top screen. This is a scene in a school of the year 2000.

By the turn of the century the use of computer-teachers and electronic devices will have completely revolutionised the educational system we know today. Classroom teaching of the traditional kind will have gone. Children will be taught individually, at their own pace, by teaching machines.

This will enable fast learners to surge ahead without being held back by others in

the classroom, while the more methodical can work the problems out at their own speed. And, because of the ingenious devices he will use, every pupil will learn his subjects much faster than he does today.

This preview of the school of the future is not as fanciful as it might seem. It may surprise you, but there are such things as the Talking Page and the Talking Typewriter, and they are being used by children today in certain schools.

The Talking Typewriter is being used in

several schools in the United States to teach young children to read. And this wonderful machine teaches children to read faster than any human teacher could.

It works like this: The machine shows the letter to be typed, and a voice, recorded on tape, speaks the letter. The child has to identify the letter on the keyboard of the typewriter. If he selects the wrong key, it will not depress. If he delays too long, the voice will repeat the letter.

In this way, the pupil at first learns to recognise the letters of the alphabet and

One of the latest learning devices is the Talking Page. With its help, children can learn almost any subject from reading to maths, at their own pace. A child of five can quickly become proficient in its use. A specially designed illustrated book is fitted into the machine, and a record disc is slipped into a slot. When switched on, the machine "talks" to the pupil, relating its words clearly and simply to the pictures and words that appear in the book. The Talking Page is already in use in several schools in Europe and America.



Left: The pupil of the future will make increasing use of the small individual projector, with its snap-in cassettes of film, providing up to five minutes of sound-motion picture. Right: The Talking Typewriter teaches young children how to read faster than any human teacher can do so. It shows the letter to be typed and a voice speaks the letter. The pupil finds the right key and presses it. A screen shows the letters typed, and a picture of the object spelt out.



SHAPE OF SCHOOLS TO COME



Some cities in the USA are experimenting with push-button teaching for young children at home. An instrument at the pupil's home is connected to a central computer, which asks questions. The pupil responds by pressing the appropriate buttons.

later to read and spell the words.

To the right of the machine there is a screen on which the correct letters appear as he types them, and when the word is complete a picture of the object which he has spelt out appears. For a small child the Talking Typewriter has something of a magical quality; he taps out C...A...T and there is a nice fat cat looking at him from the screen.

The showing of educational films usually involves gathering the students together in a special room, or pulling down the blinds in the classroom and setting up a projection screen.

The pupil of the future will probably use

a more compact movie-projector, like the one recently produced by another American company. It weighs only two pounds; it can be held in the hand like a book, and includes a sound track. It runs on two flashlight batteries and can be used in bright daylight, focusing on practically any flat surface. Snap-in cassettes of film provide up to five minutes of sound-motion pictures.

Photographic transparencies, or slides, are not new to the classroom, but some recent modifications are. A slide projector has been developed that combines sound and pictures. The portable unit is little bigger than a typewriter and can be operated manually or automatically, forward or backward.

The Telecure will also be used a lot in classrooms of the future. This is an amplified lecture telephone. It can be connected with a central tape library holding a vast variety of information that a single school would never be able to acquire. By a simple twist of the dial, the teacher can let the class hear recordings of talks by leading authorities on the subjects being studied.

Language instruction lends itself well to modern electronic methods. The Lingua-phone company, a pioneer in language teaching, has produced a double-track magnetic tape that allows the student to hear his own voice and compare his pronunciation with that of the expert on the tape.

Push-button computer teaching is being experimented with in several cities in the United States. The system is known as Dial-a-Drill. With the aid of a twelve-button Touch-Tone telephone in each of the children's homes, a central computer can drill up to 2,000 pupils in the age group of seven to eleven in the fundamentals of arithmetic.

Not only can the children record their answers on the phone in their homes, but a teacher at the central data station can reach the students individually.

Here is how it works. A computer, programmed to drill the students orally at their own rate, is connected to a multiple data station. A teacher at the station calls a pupil and, finding that he is ready for his lesson, transfers him to the computer. The computer sets the pupil mathematical problems of varying degrees of difficulty, depending on each child's ability.

The pupil responds by pushing the buttons on the Touch-Tone telephone. If a wrong solution is given, the child is told so by the computer, which at the same time gives a clue to the correct one.

PLAN For Learning

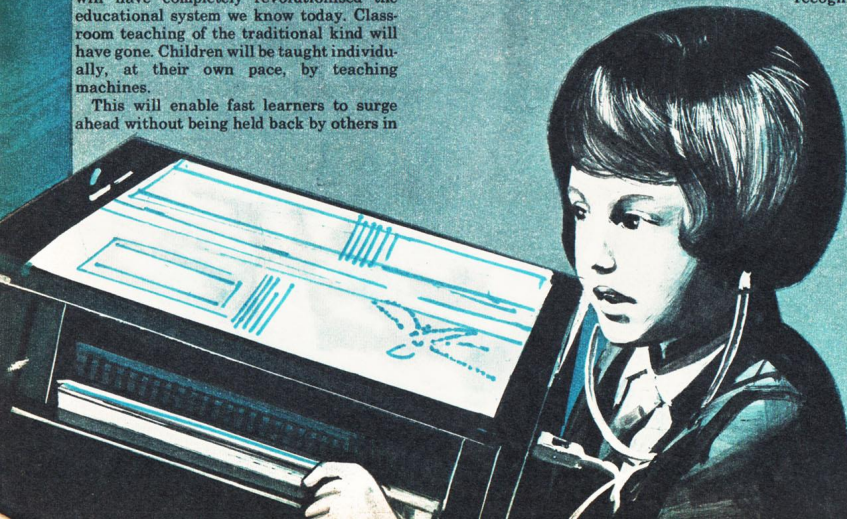
Project PLAN (Programme for Learning in Accordance with Needs), now in operation in some 24 American cities, is really a blueprint for the future. Students work with some 25,000 learning assignments that have been fed into a computer.

Capable of teaching many subjects from elementary to secondary school level, the computer sets out three weeks' work for a student. When he has finished, the computer grades his result and gives him the next assignment.

Will human teachers be necessary in such a fully computerised educational system? Yes indeed, but their basic responsibilities will have changed.

While technical advances make it easier for pupils to work at their own pace, and give them greater freedom of choice, they raise fresh problems in the checking of pupils' progress and the general control of their activities. But here again computerised equipment will come to the teachers' help.

Teachers in the year 2000 will be experts in the operation of a great variety of electronic devices, and masters of programmed learning procedures.



BELTING THROUGH THE CITY STREETS

futurescope

Conveyor belt travel could well solve the problem of traffic jams in our already overcrowded cities

The Carveyor—a conveyor belt fitted with small covered “cars” could be built into existing city streets. Branch belts would carry passengers to the shops, theatres, and railway stations.

Express trains take people from one big city to another at speeds of more than a mile a minute. But when the travellers reach their destination it may take them anything up to an hour to travel through city streets as their bus or taxi slowly moves from one traffic jam to another.

Transport authorities have been trying for years to solve this problem of speeding up travel in crowded streets. But city traffic gets slower and slower. Although many ingenious ideas have been suggested to cut travel-time, the traffic jams remain.

Most traffic experts blame short journeys by bus and other motor vehicles for most of the traffic jams in the middle of cities. They believe that some entirely new form of transport must be introduced in the near future if city traffic is not to grind to a halt.

One suggestion is the Carveyor. This consists of a network of conveyor belts, such as those used for moving goods in factories, which would be laid along the sides of existing streets.

Fixed to the belting would be covered seats for passengers. The belting would be driven by electric motors and there would be exchange points at street crossings and intersections. In this way people could travel to any part of a city by the Carveyor.

The conveyor belt carrying the seats will travel at 15 miles an hour. Running parallel with the main belt will be three others. The one nearest to the main belt will move at twelve miles an hour, the one next to that at seven miles an hour, and the third belt will travel at three miles an hour.

Easy For Passengers

To get on to the main belt and take a seat on the Carveyor itself, the passenger first steps on to the slowest moving belt, then on to the second, next the third and finally on the Carveyor. Passengers leaving the Carveyor will step on to the different belts in turn and finally on to the pavement.

Stepping on or off the moving belts will be no more difficult than stepping on or off an ordinary escalator. In fact the speeds of the four belts are so timed that passengers will hardly notice the sudden change from their walking speed on the pavement to the 15 miles an hour on the Carveyor.

At railway stations, theatres and other busy boarding and alighting points there will be Carveyor depots where branch belts from the main belt will stop to load or unload large numbers of passengers at a time

and then move off to link up with the main Carveyor system.

There will be no conductors on the Carveyor to collect fares. Instead passengers will buy from a central office or shops on the route books of 25, 50, 100 or 200 tickets valid for travel at any time and for any distance.

Periodically inspectors will board the Carveyor to check tickets and make sure that no one is trying to travel for nothing. Experts who have examined the plans for the Carveyor say that the system will be cheaper to operate than fleets of buses.

Another proposed solution to the problem of speeding up traffic in cities is the computerised personal car system invented by William Alden, an American railway en-

gineer. His system consists of electrically-driven cars travelling on a track and taking current from a conductor rail. Each car carries one to six passengers.

The tracks would be laid between all important traffic points such as railway stations, airports, large hotels and blocks of flats, car parks, post offices and theatres. At these places there would be lines of the cars waiting at sidings. The cars would be standing in lines according to the number of passengers they were meant to carry.

When a passenger gets on a car he will see in front of him a panel with rows of buttons. Each button represents one of the places served by Alden's system.

When the passenger pushes the button for the place he wants to go to, an electric signal is transmitted to a central computer. In a few seconds the computer works out the route, adjusts the points on the network of tracks, and the car will have a clear run.

Safety Devices

Within half-a-minute of pressing the button, the passenger is being whisked on his journey at a speed of 40 miles an hour. If for any reason a car strays from the course set for it by the computer, automatic safety devices come into instant operation. The car stops and no other cars are allowed in that section of track until things have been put right.

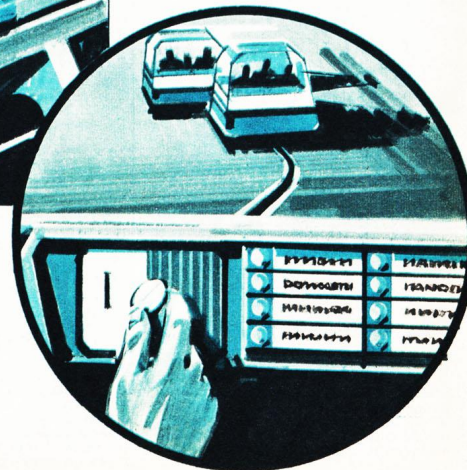
As with the Carveyor system, fares are not collected on the Alden railway cars. Instead, there is a coin-slot box beside the rows of push buttons on each car, and none of the buttons can be pressed until a coin for the exact fare has been slipped into the box.

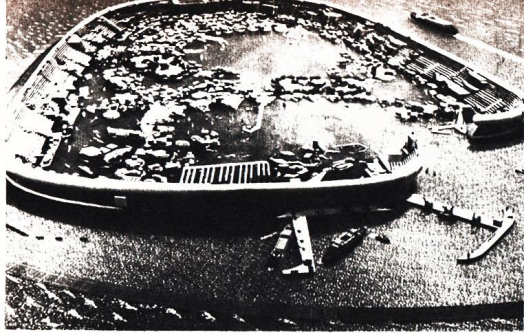
Alden claims that one of his computer-controlled automatic railways would be able to carry 30,000 passengers an hour.

It is hoped to lay a trial length of the line within the city of Boston, Massachusetts, some time this year. Transport engineers will watch the experiment with interest, for many of them believe that it may be one type of transport for the city of the future.



Electrically-powered cars running along a single conductor rail offer another possible system of future city transport. Passengers could programme the car for their destination by pressing a button inside and paying their fare by putting a coin in a slot.



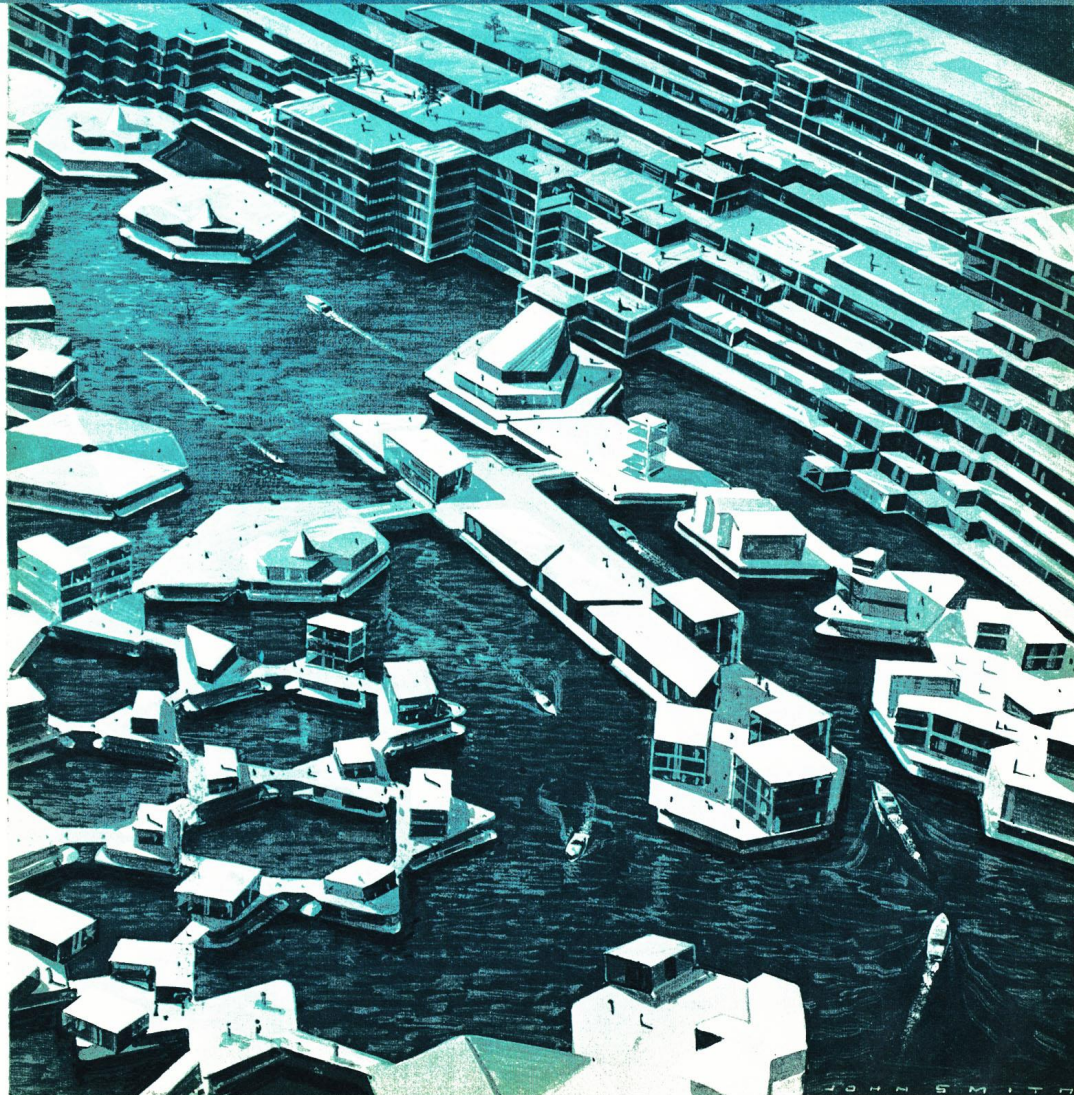
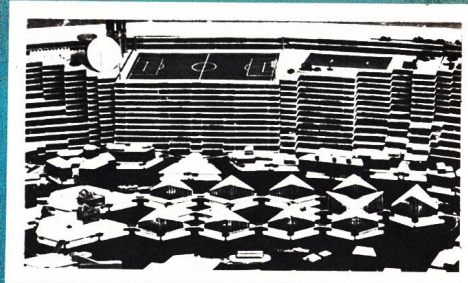


The projected Sea City has an outer floating boom to protect it from the sea's turbulence, and an inner wall 180 feet high. On the wall's inner side are 16 terraced storeys of housing, while smaller blocks of flats and other buildings will be accommodated on floating islands in the enclosed lagoon.

LIFE ON THE OCEAN WAVE

futurescope

A rapidly growing world population will soon be crying out for living-space. Planners and scientists have come up with one possible solution: Build on the sea!



The way things are going today, the idea that Man is a land creature only may well have to change completely.

The seas and oceans of the world cover something like 70 per cent of the Earth's surface, and at the moment this enormous area is virtually uninhabited by Man. The other 30 per cent is occupied by land—and, as everyone knows, that land is becoming more and more overcrowded as the world population grows and grows.

As we suggested in a previous article (*Talking Point, WORLD of WONDER* No. 67), one solution to the problem might be found in the exploitation of this vast amount of space—138 million square miles of it—that is now going to waste.

This is an idea that architects all over the world have been working on for some time. For example, in 1950, the Russians began developing an offshore settlement near Baku on the Caspian Sea. In 1960, the Japanese were planning to extend Tokyo, the largest city in the world and one of the most heavily populated, into Tokyo Bay. In 1965, the Americans began erecting prefabricated islands to make homes for sulphur miners in the Gulf of Mexico.

City At Sea

In 1968, a group of British architects, members of the Pilkington Glass Age Development Committee, went one step further and designed a complete city to be built at sea. It would contain about 28,000 people who would live in a horse-shoe shaped area of just over half a square mile.

The site of Sea City would be on the shoals in the North Sea, 15 miles off the coast of Norfolk. This type of coast is found in many parts of the world, but in the case of the North Sea there would

be the added advantage of ready access to under-sea natural gas.

The North Sea, of course, is a pretty inhospitable place. Fierce easterly gales blow over its surface at times, and off some of its shores the water freezes over in severe winter weather.

The people of Sea City, however, will not be bothered by such conditions. They will be protected by an outer floating boom and an inner wall. The wall will be about 180 feet high, and S-shaped in section. Wind-tunnel tests have shown that it can deflect winds harmlessly over the top. It will be built on piles sunk in the sea-bed.

Islands In a Lagoon

Inside the wall will be a calm lagoon, the waters of which will be artificially heated. This will furnish a means of controlling the climate in the city, and maintaining a pleasant temperature.

A majority of the population will live in 16-storey terraces constructed against the inner face of the wall. The buildings will be so arranged as to receive at least two hours' sunlight a day, even in winter. Others will live in two- or three-storeyed blocks on floating islands in the lagoon.

The 21,000 people who live on the terraced blocks and the 7,000 who live on the floating islands will all find it very easy to travel about Sea City.

They can have their own private electric boats—no diesel- or petrol-driven craft will be allowed inside the lagoon—or they can ride in one of the eight water buses which circle the lagoon every 15 or 20 minutes.

Sea-citizens can also travel on foot, either by escalator or under their own steam. All the floating islands are connected by covered walks built 14 feet above water-level. It is also possible to walk direct from island to island, because their triangular shape enables them to be hinged together into units of various sizes.

Entertainment and leisure activities are not neglected. There will be an under-water zoo, for example, and such sports as skin-diving, water-skiing and yachting will take place in a special

Full provision is made in this revolutionary plan for all the needs of its citizens, including leisure recreation. Public gardens and sports grounds will be included. Our picture shows a football pitch laid out on top of one of the terraces.

recreation area.

Football, cricket, tennis, bowls, croquet, netball—people in Sea City will be able to play all of these on special pitches and courts laid out on the roofs of buildings.

Young children will be able to play on an artificial sandy beach which will be laid on a firm concrete foundation, and washed clean by the rise and fall of the tide in the lagoon.

Anyone who just wants to sit down and relax in the open air can do so in one of the public gardens, which will be planted with trees, bushes and lawns just as they are on land.

Another plan for using sea-space is one being investigated by Eurocean, an international organisation which exists for the exploitation of the seas around Europe. This project is for an artificial island off the Dutch coast. It would serve as an oil-port and industrial centre, and would take advantage of a piece of land known as Brown Ridge, lying at about sea-level some 60 miles out to sea.

Pollution Worries

The island would be five miles long and three or four in width. The idea was first suggested by famous French under-sea explorer Jacques Cousteau (see *WORLD of WONDER* No. 3).

One point quoted in favour of the proposal is that the use of such an island would save the mainland countryside and rivers from chemical and industrial pollution. But it would be necessary to ensure that the pollution was not merely transferred to the sea.

Dwellers in any kind of Sea City would not need to lose touch with friends ashore. Quick trips could be made to the mainland by helibus or hovercraft. Any sea-citizen doing this would find himself the envy of those compelled to stay on the overcrowded land.

Part of Sea City's interior, showing a section of the terracing on the inner face of the wall, and a corner of the lagoon, with its floating islands. These can be towed from site to site as required. The water of the lagoon is artificially heated to provide a means of controlling the city's climate.

futurescope

YOUR BODY'S A RADIO STATION

When a doctor is in doubt about the illness from which a patient may be suffering, the first thing he does is to take the patient's temperature and count the pulse rate. Both these can tell him quite a lot about the patient's condition, but they cannot tell the doctor what the actual disease is. To make a proper diagnosis, the doctor must carry out a lot of other tests.

Many of the tests used today take a long time and are not always exact. What the doctor would like would be some device which told him quickly and accurately exactly what is the matter with a patient.

The day when doctors have such a device may not be far off. Electronic equipment for checking the symptoms and progress of hospital patients is already in use (see *WORLD of WONDER* No. 91). A further advance may see the doctor actually listening in to the patient's body with a radio receiver, instead of using thermometer and stethoscope.

Medical scientists have discovered that your body is rather like a broadcasting station. In other words, you radiate electro-magnetic waves in much the same way that a radio station transmits and broadcasts a television programme.

Mysterious Signals

It all started when radio engineers were experimenting to produce a super-sensitive receiver. They began receiving signals which they could not identify as coming from any known broadcasting station.

Not only were the signals very weak, but they were quite unlike anything they had ever picked up before. After

*Whether its
measles,
mumps or
just a tummy-
ache, soon
the doctor
may be
able to spot
your ailment
by simply
tuning in on
a super-
sensitive
radio
receiver*

puzzling over the programme for a long time, they suddenly realised that the signals were coming from their own bodies.

When medical scientists heard about the mystery body-signals they too became interested. So they started their own experiments.

As a result, the doctors found evidence to indicate that each of the various organs inside the body has its own radio wavelength. And these wavelengths each gives its own particular signal which can be picked up by tuning in with a special type of receiver.

The electrical energy responsible for broadcasting from within the human body appears to come from the food we eat. Besides feeding our bloodstream and building bone and muscle, food taken into the body generates a small

amount of electrical energy. The energy is very weak, but it can be detected.

Indeed, it would appear that your body can be compared with a power station. Heat from the coal, oil or atomic fuel boils the water that produces the steam to drive the turbo-alternators that generate electric current. When you eat a meal, a similar process happens inside your body.

Working closely with medical scientists, electronic engineers have been able to design an extremely sensitive radio receiver linked to special detecting instruments and meters. The device can pick up and measure very accurately the tiny radio signals transmitted by your body.

Changes With Age

One interesting fact found out about the signals is that their strength from any one person varies according to age and health.

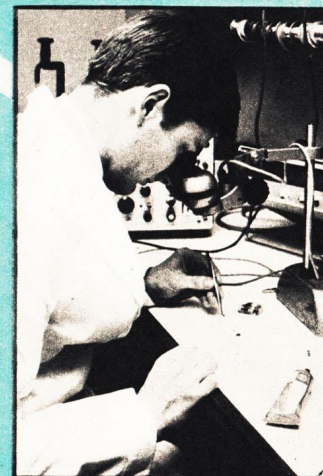
Considerable success is also being made towards designing an instrument which will be able to receive an immediate and easily-recognised signal from any organ in the human body.

The signals received by the instrument will be converted into electrical impulses which can be used to move a pen across a strip of graph paper. Changes in the line drawn by the pen will, it is hoped, give the doctor valuable information about a patient's health.

In other words, the doctor will be able to tune in to the heart, liver, lungs, kidneys, brain or any other human organ. From the strength of the signal



A woman doctor using electronic apparatus to examine a patient who is suffering from a throat condition. The piece of equipment beside the couch is called a Body Function Recorder.



A "radio pill" being assembled in the medical electronics department of a hospital. Followed by the patient, it will transmit signals at varying frequencies. These can be interpreted to furnish information about the condition of the patient.

he receives, he will then be able to decide whether or not any particular part inside the body is unhealthy.

Looking farther into the future, medical scientists believe that one day a doctor will be able to diagnose a disease by its wavelength. To do this, the doctor will have to have a combined transmitter and receiver.

The idea for this new medical aid came from the discovery that the germs of various diseases absorb high-frequency electrical impulses at certain

definite frequencies. In other words, it is thought that every disease has its own particular wavelength.

Scientists have already managed to find the wavelengths of a number of common diseases. The wavelengths have not yet been accurately measured, but if this can be done they can be marked on a tuning scale in the same way that broadcasting wavelengths are fixed on the tuning dials of a transistor radio.

A Patient's Graph

In order to diagnose a complaint by listening-in to it, the doctor will connect his patient to the transmitter and then watch a graph being drawn by the receiver. He will transmit the wavelengths of various diseases until he gets a signal showing that it is being absorbed by the patient's body.

If the wavelength absorbed by the patient's body is the same wavelength that would be absorbed by a particular germ, the doctor will know at once that that germ must be present in the patient's body.

Radio diagnosis by tuning in to the human body is still in the experimental stage. But medical scientists are certain that one day your doctor will connect you up to a radio receiver and tune in to your body. When that day comes the stethoscope and the clinical thermometer may well become museum pieces.

Every year the world's demand for oil and still more oil increases, and to meet the demand bigger and bigger tankers are going into service to carry the hundreds of millions of tons of petroleum that have to be shipped from the wells to all parts of the world. Shipping charges cost more than the actual value of the oil when it leaves the wells, but these charges are greatly reduced by the use of the super-tanker.

There are super-tankers at sea able to carry up to half-a-million tons of oil in one load. Now a shipping company is planning to build a super-super-tanker to load a million tons of oil at a time.

But the giant tanker is already posing a serious problem: making the ship's keel strong enough to support a weight of a million tons or more. An oil-

tanker's keel is its backbone, and many a tanker has been wrecked by breaking its back in a storm or through running aground.

When a tanker is caught on the crest of a huge wave, there is nothing to support the bow and stern, and the whole weight of the ship is resting on the middle of the keel. You can get some idea of what happens if you support a thin plank of wood at its centre. The wood bends upwards in the middle and the ends dip down.

Very often when a tanker runs aground on a shore or rocks, the whole weight of the ship is on one part of the keel. That is what happened to the famous Liberian tanker *Torrey Canyon* in March 1967. She ran aground on the Seven Stones Reef, between Cornwall and the Scilly Isles, and broke her back so that thousands of tons of oil leaked out of her broken hull.

Another risk of a tanker breaking her back is when she is caught in the trough or hollow between two giant waves. Then there is nothing to support the middle of the ship and the keel tends to bend downwards.

It is the case of the plank of wood again. Support it at

each end and the centre bends downwards while the ends tip up.

So it is not surprising that the building of super-tankers with keels able to support the tremendous weight of the loaded ship has become an increasingly difficult problem that must be solved by designers.

One solution to the problem has been suggested by a Japanese company which specialises in super-tankers and is planning to build a monster of 700,000 tons. The ship will be nearly 1,200 feet long, and her keel will have to bear a fantastic weight.

A Hinge of Pins and Sockets

Instead of giving this ship an exceptionally strong and heavy keel, the Japanese designers propose to build the tanker in two halves. The fore and aft sections will then be joined together with huge pins and sockets.

The pins and sockets will act like a giant hinge, so that the ship will arch and bend its back according to the shape of the waves and troughs under its keel.

To prevent the seawater from leaking into the ship where the two halves of the hull join, the sides of the tanker will be built up of several walls of plating on both sides of the hinge. These walls of plating will fit into one another in much the same way as when you interlock the fingers of your two hands. The drawing shows you how the walls of plating on the tanker will interlock.

When the hinge causes the tanker to arch or bend its back according to the action of the sea, the walls of

Continued on next page

In calm seas the super-tanker that is hinged amidships will behave much the same as one with a conventional rigid hull, since the two sections of the ship will maintain a virtually horizontal position.

When the sea lifts the tanker in the middle, the hinge allows the bow and stern to subside with the water on each side of the wave, so that the weight of the hull's extremities will not break its back.

When waves lift the ship fore and aft, the action of the hinge allows the middle of the hull to settle into the trough between, so avoiding the risk of the unsupported centre breaking under the strain.

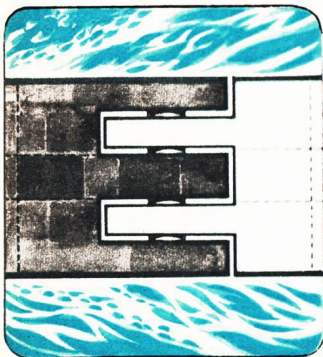
futurescope

Ship That Arches its Back

If you can't beat the waves, join them! That's the latest idea for enabling giant tankers to avoid breaking their backs in rough seas

Ship That Arches its Back

Continued from previous page



What it would look like from above: a bird's-eye view of the giant hinge that joins the two sections of the hull, enabling the ship to adapt itself to the motion of the waves and avoid the danger of breaking its back.

plating will move in unison with the arching and bending of the keel.

Each half of the ship will have strong bulkheads or cross-walls on either side of the hinge, so that the tanker will be absolutely watertight. In the unlikely event of the hinge breaking, the two halves of the ship will remain afloat.

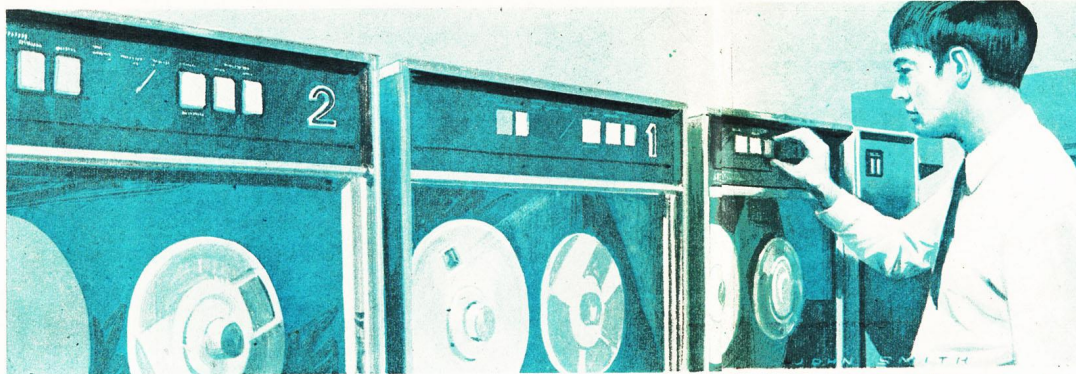
Giants In Rough Seas

Japan has already built a small ship with the hinged keel and this is now undergoing sea-going tests. This will give the builders the information they need when they come to build the 700,000-ton tanker.

So before long we may see giant tankers sliding through rough seas in the same way that a snake slithers across uneven ground.

One great advantage of building ships with a hinged keel is that the vessels can be built separately in two halves and then floated together to be joined up by the hinge. At present special long and expensive slipways have to be used for the building of super-super-tankers. The slipways add a lot to the cost of the ship.

Being built in Japan now is a super giant of 477,000 tons. She is, of course, in one piece, and it seems likely that this tanker, the *Globtik Tokyo*, will be the last of the great "unbenders".



THE COMPUTER - Part 2

THIS AMAZING MECHANICAL IDIOT!

The game of draughts has existed for over 3,500 years and has produced many fine players who have all learned from the ploys of past masters. Robert Nealey had played since childhood, was a champion in the United States and had been defeated by no one for eight years when he faced his next opponent, a comparative beginner who had started to play only seven years previously.

In short, Nealey was defeated roundly by his opponent who received no assistance whatsoever from anyone. And the opponent? An IBM model 7094 computer!

Whatever the feelings of Nealey, to the spectators, the contest was unnerving. Some wiped their brows uneasily at this demonstration of highly developed intelligence. One day these machines really are going to take us over, they muttered with apprehension.

Yet only last week we were saying that computers are actually rather simple and straightforward. We saw that when someone is asked a question, the sound waves of the voice are broken down into electrical impulses which is the kind of "shorthand" with which the brain can deal.

Bits of Information

Perhaps one could best compare this with the Morse code which expresses words and whole sentences by just two symbols—the dot and the dash.

That is exactly how the computer works. All the knowledge it deals with must be broken down into *bits*, as they are called;

**Could computers take over the world?
No—unless all the people who programme them suddenly decided they wanted to be dictators!**

that is, minimum units of information. Whereas the Morse code uses dots and dashes, the computer uses the symbols 0 and 1, as you may have read in *WORLD OF WONDER* No. 1.

What, in fact, the computer needs is a language of its own which can be expressed in mathematical terms and thus in electronic terms. So, if your name is Bob, it would appear in computer language as 11001 (B), 11000 (O) and 11001 (B) again. Then all these 0s and 1s can be expressed as electrical impulses.

All our electronic "brain" is, then, is a super-efficient calculating machine doing simple arithmetic at the speed of electricity provided by transistors. It can manipulate numbers, but to do so it must work to a



One expert has suggested that a SpheX wasp is a good example of the way in which a computer works. This wasp stuns crickets and takes them inside its nest. But first it leaves the cricket at the entrance and goes inside to make sure everything is safe. An intelligent move, it seems. But if someone moves the cricket back a few yards, the wasp retrieves it and does exactly the same thing again. It doesn't remember that the nest is safe. This limited repetitive behaviour sums up the limit of the computer's ability.

master plan provided by the programmer. In other words, it always has to be *told* how to do its sums.

You're still not sure? We'll look at a simple example. Take 32 playing cards and try to find the Ace of Hearts. How would you do it? Just shuffle through till you found it? That's all right. But suppose you were asked to go on doing this repetitive task time after time?

You could go about it more methodically. How many *bits* of information would be required to solve the problem in terms of "yes" or "no"—or, if you like, 0 and 1, the computer terms?

First you divide the 32 cards into two piles of 16, then you ask if the card is in the first pile. No. So obviously it's in the second. Now you divide this into two piles of 8.

Again you ask the question, and so on. By the time you come to ask the fifth question there are only two cards left and you have found the answer.

A computer is basically a simple thing, so it has to be educated simply. And sometimes it isn't, perhaps because the programmers work out a wrong programme for it. This is where human error creeps in.

Computer-Wise

Sometimes the computer has too many alternatives and gets confused. For instance, some computers translate one language into another. Easily the best story was the translation of one well known phrase: "The spirit is willing, but the flesh is weak." What came out in the other language was: "The whisky is pleasant, but the meat is no good."

You can hardly say it was wrong, can you? But you see what we mean? The computer can be idiotic without knowing it.

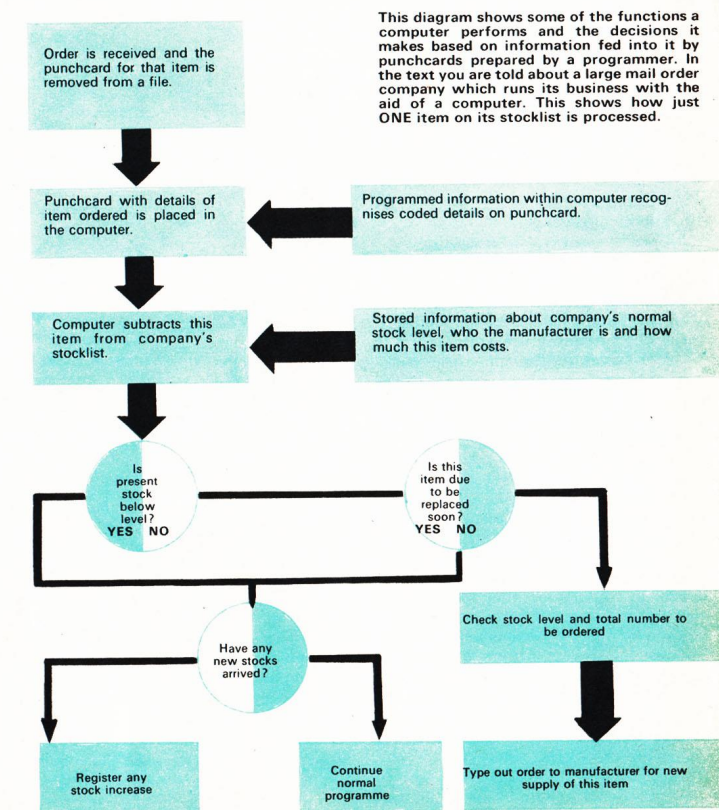
Then we have to worry about the humans who run the computers. Sometimes they forget to cancel a previous instruction.

One computer in America did just about everything for the mail order firm it worked for. It kept the books in order, noted when stocks were running low, advised when bills were due to be paid, dispatched reminders to customers and sent out instructions for new catalogues to be sent to them. Alas, there were no instructions to stop after the last customer on the list. As a result, a lorry turned up outside a man's home and deposited several thousand catalogues on the lawn!

So lots of things can go wrong. But already many computers are being taught to recognise their own mistakes and sound an alarm when something does go wrong—something essential when the computer may be controlling the countdown of say an Apollo space-launch.

However, assuming that the present day errors of computers will eventually be eliminated, what can we expect—for better or for worse—from our future electronic "brains"?

Next week we'll be looking at the present impact of the "electronic revolution" on the 20th century.



futurescope

NEW WAYS OF MAKING SHIPS

A new type of shipyard, which will build ships in bits, is taking shape in America and could be a model for all ship construction of the future

When Henry Ford introduced the assembly line system to motor-car production in the early years of the century, he revolutionised the industry.

Instead of his workmen walking to various car components in different parts of the factory, he installed a conveyor-belt, a kind of continuously moving work-bench, that carried the components past a line of workmen.

This idea saved a lot of precious time, proved more efficient, and cut the cost of production. Today, a similar revolution is happening in that most traditional of industries—shipbuilding (see *WORLD of WONDER* Nos. 94–95).

Nearing completion in the United States is an automated shipyard that will use assembly lines to build all kinds of vessels. And this, the experts predict, will be the first of the new-style shipyards of the future.

Big ships are normally built one at a time, with hundreds of workmen swarming all over the giant structure like so many ants. Mind you, it is more organised than it appears to be but there is still a great deal of wasted time and effort.

With their new automated shipyard, the American firm of Ingalls West have established a new pattern of mass ship

In the modular assembly area of the automated shipyard, the sections that go to make up a ship are welded together from parts transported from the shell assembly and panel shops.



production. It is the only new American shipyard constructed in over 25 years, and its efficient and highly mechanised system is laid out in a daring and imaginative way.

The "ship factory" covers an area of 600 acres. A computer-controlled system will speed operations and keep down costs to an absolute minimum. Work will be brought to the worker, a factor of great importance when much time is normally lost transporting workmen and materials to the ship, and where work is performed in restricted spaces.

Collecting the Parts

Let's see how this shipyard of the future will operate. First, steel plates and metal sections are brought to the raw material storage area; these are then carried by crane and conveyor to the fabricating shop for processing, then to the panel shop or shell assembly shop for further shaping and welding into complete panels and shell assemblies.

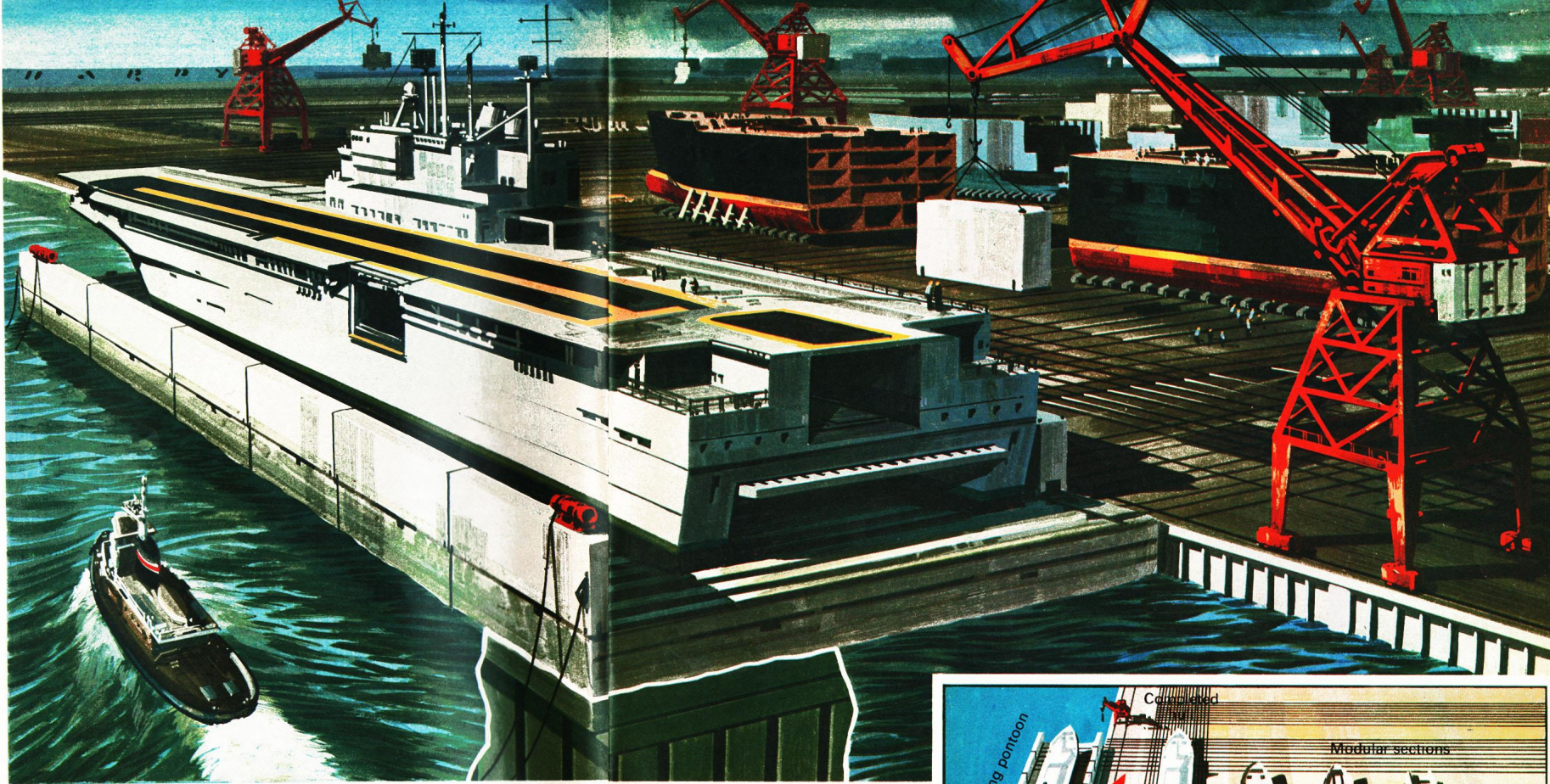
They are then transferred through the staging and kitting area to the sub-assembly area where the sub-assemblies are completed and outfitted. The sub-assemblies are then moved to the module assembly area.

The completed modules, each weighing 1,500 to 2,000 tons, are moved to the ship assembly area where they are joined to form the structurally-complete and outfitted ship.

The ship is then transferred to the launching position, where it is launched from a pontoon and then towed to the fitting-out dock. The pontoon launch system—which is unlike any other launch system in operation—will be able to handle mammoth ships 1,000 feet long.

The pontoon launch is essentially a floating dry dock. When the modules that make up the ship have been put together, the vessel is moved by the rail

Once the hull of the ship has been welded together it is carried sideways on rails on to the launching pontoon. This is a floating dry dock which can be towed to the launching channel where it will be partially filled with water so the ship can be floated off.



Roll on – float off – that's the way vessels are launched at this

modern ship factory

system on to the pontoon. The pontoon is then taken into the launch channel area where the ship is floated off. A tug tows the ship to a dock site.

Ingalls West claim several advantages for the pontoon launching system. There is much greater control during the launching, with less danger of damage. It allows ships of various sizes to be handled, and it is cheaper and quicker than the normal method of launching.

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Out of the new shipyards of the future will come a new breed of container-ship—the gigantic "roll on-roll off" transport vessel. Unlike the container ships of today, where the cargo—packed and sealed in special box containers—must be lifted on and off by cranes, the roll on-roll off ships will only carry cargo in wheeled vehicles capable of being driven or towed.

"Trailer" Ships

Surprisingly enough two of these "trailer" ships are already in operation, carrying wheeled cargo between New York City and Puerto Rico. These ships, the S.S. *Eric K. Holzer* and the S.S. *Ponce de Leon*, owned by the Transamerican Trailer Transport company, are the forerunners of larger and faster roll on-roll off vessels to be built for

trade between the United States and Europe.

Both ships are sparkling white, 700 feet long and 105 feet wide, and because of automation only a small crew of 35 is needed to run one of these 24,000-ton vessels. In port, vehicles roll on and off the ships over three side ramps simultaneously.

The *Eric K. Holzer* has set record loading and unloading times of ten hours in New York City and eight hours in Puerto Rico; compare this time to that of conventional container-ships which require four or five day turnabout time.

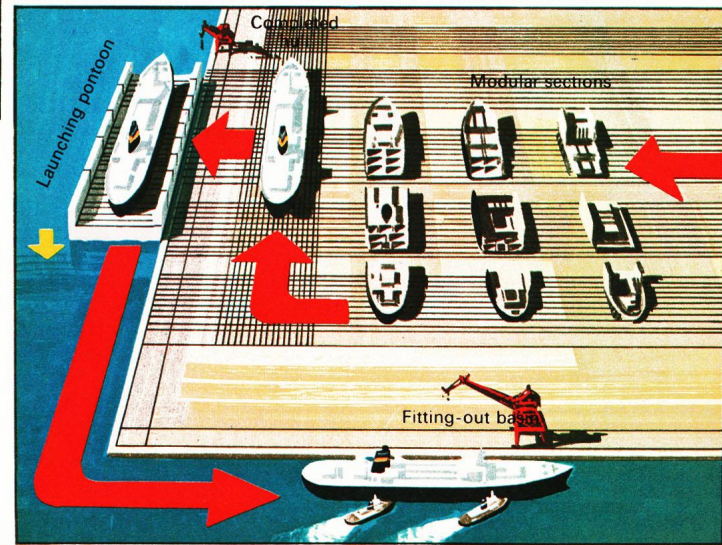
These two super cargo vessels are

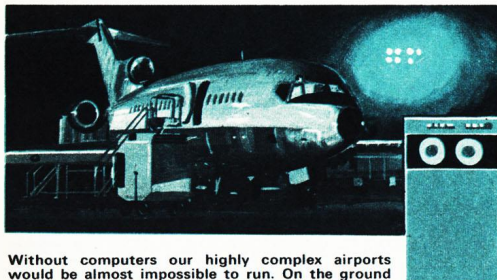
modern ship factory

part of the "advance into the future" programme of the U.S. merchant marine, a scheme proposed by the American government and which calls for the building of 300 new ships in the next ten years. Other countries are also increasing ship production.

And to meet the demand for more and more ships—especially cargo vessels—it is certain that automated ship factories will be established all over the world in the future.

This plan of the modular assembly area shows how the sections of the ship, mounted on rails, are mated together and transported on to the launching pontoon, before being floated and towed to the fitting-out basin.





Without computers our highly complex airports would be almost impossible to run. On the ground computers handle passenger bookings, crew organisation and aircraft servicing. In the air they constantly check aircraft altitude and navigation so that corrections can be made to ensure that aircraft are on a selected course.

They organise the payrolls of big companies, do the 'ledger work' in banks and sort out mail swiftly to speed it across the country.

They even help to keep traffic flowing in big cities, switching on and off traffic lights in those streets that most need controlling at a particular time of the day. It must be admitted, though, that this type of operation is in only an experimental stage.

Up in the air, the whole pattern of aviation is being altered by the 'electronic brain'. Central computers now deal with all bookings, crew organisation and servicing facilities, so that airliners are used to their greatest advantage.

Press-Button Knowledge For All

Press a few buttons and passengers can find out just what seats are available and when and at which airport to change to reach a destination in the fastest possible time.

Computers hold planes and ships on course by keeping an electronic eye on compasses and altimeters, and automatically level out deviations from the predetermined route by correcting steering gear. In America, it is even possible now for two supersonic fighters to streak towards each other head on and one swoop down, the other up, as sensitive radar antennae tip off the computer to make a swift automatic safety manoeuvre.

Are you a boxing fan? Did you ever debate what might have happened had undefeated Rocky Marciano in his prime fought undefeated Cassius Clay in his? A computer did. Every statistic about the two was fed in and a mock film made following its instructions. For the record, Rocky won by a knockout.

Do you ever think about getting married one day? If so, what are your chances of finding the ideal partner? Well, you could try asking the computerised 'cupid'. This is already being done. Personal, psychological and physical characteristics are fed into the computer with a preference for the sort of partner desired—say, tall, gentle, kind, rich and interested in books.

A Question of Accuracy

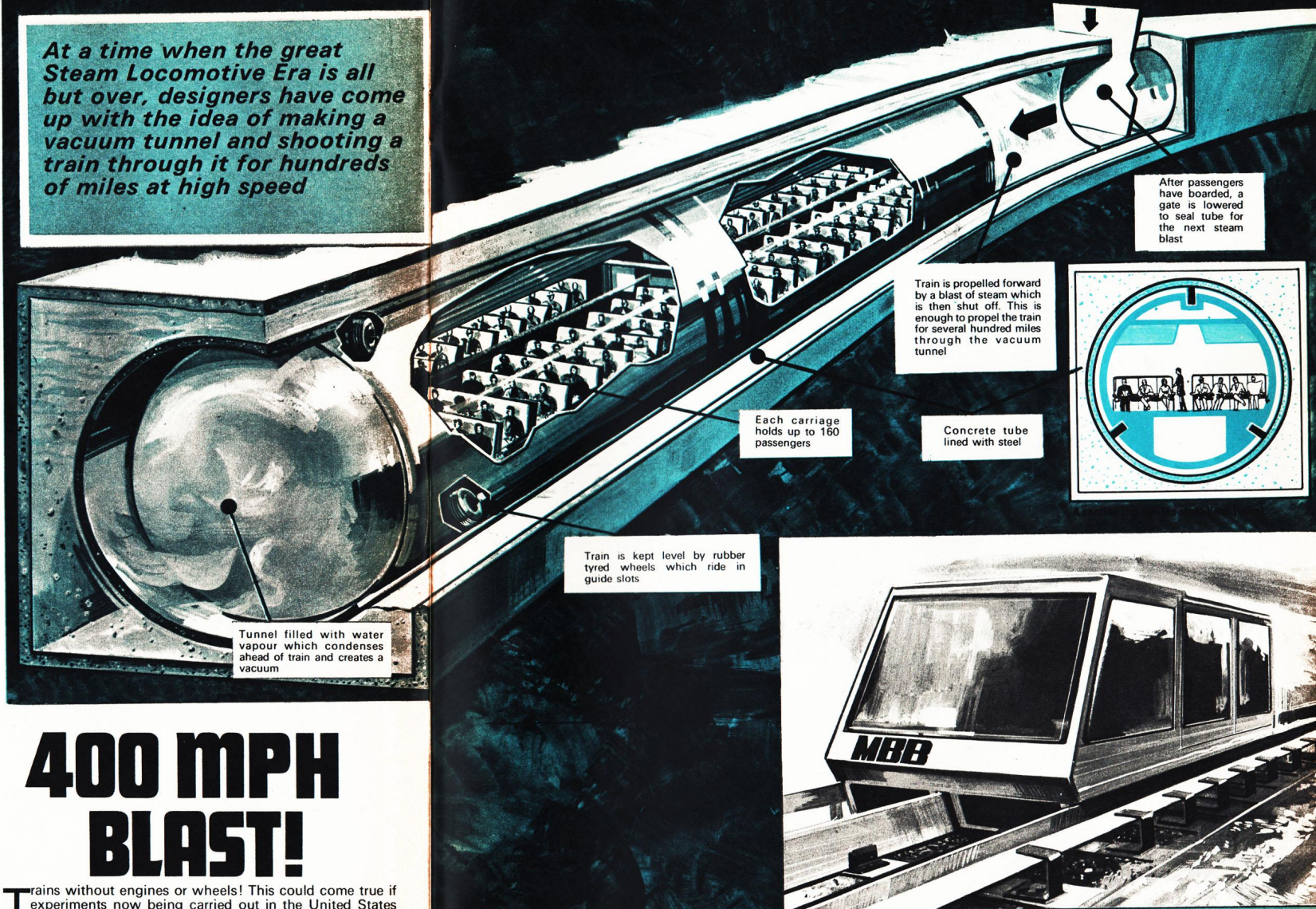
The computer can swiftly spot such a partner who in turn is looking for a person with exactly those characteristics that the other person possesses.

One other big question rears up, too, when the use of computers today is considered. And this question assumes that the computers are accurate when they perform their allotted tasks. Can a company that installs one really afford to use it or know how to use it best?

The managers of one firm spent millions computerising and automating their industry, but did it so well that they flooded the market with their goods, sold very few more as a result and could no longer afford to stay in business. The computer had literally swallowed up their fortune.

Yes, praise the computer or beware of it. But anyway it's here to stay. For better or worse, it's going to have an even more fantastic effect on our lives in the years and centuries to come. And it's that future at which we shall be looking next week.

At a time when the great Steam Locomotive Era is all but over, designers have come up with the idea of making a vacuum tunnel and shooting a train through it for hundreds of miles at high speed



400 MPH BLAST!

Trains without engines or wheels! This could come true if experiments now being carried out in the United States are successful.

One of the big problems facing designers of high-speed trains is the build-up of air in front as it speeds through a tunnel; the faster a train goes, the greater the power needed to overcome this resistance. To solve this, designers have now evolved the idea of propelling a train through a tunnel which contains no air; in other words, a vacuum.

The new system has no need of engines to provide the power. Instead the tunnel is filled with water vapour and a blast of steam used to push the train along at speeds of up to 400 mph, rather like a piston in a very long cylinder. As the train shoots through the tunnel the pressure created in front

MACHINES AT WORK

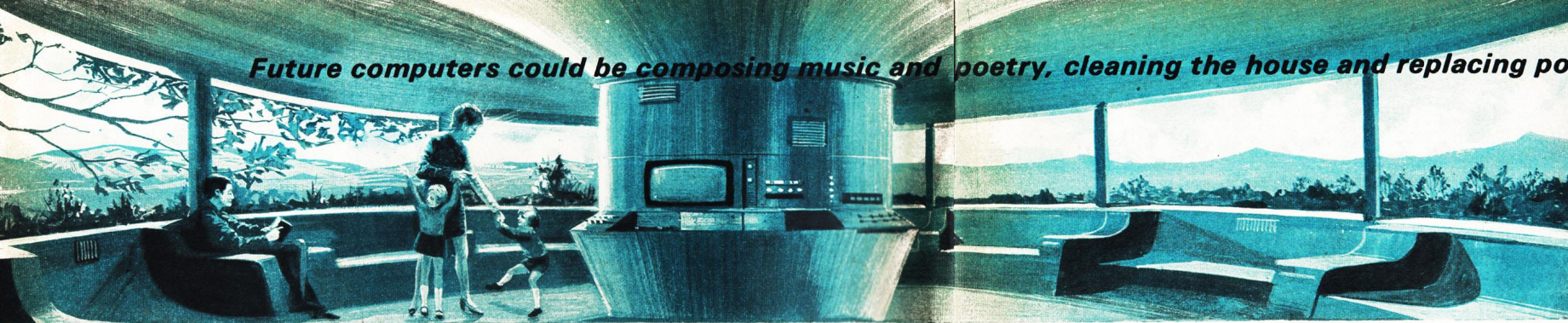
causes the steam to condense on the walls, leaving a near vacuum.

A single blast of steam would enable the train to travel for several hundred miles without stopping. At each station a fresh blast would send it on its way again.



Another train of the future, now being tested in Germany, is shown above. This uses an electromagnetic field set up in a single 'rail' to provide power. Inside the rail is a coil of wire rather like a long electric fire bar. The engine also has a coil inside it and when the electricity is switched the two coils react against one another to move the train. Braking is achieved simply by reversing the current flowing through the coils. A prototype has already reached 62 mph and by the 1980s it is planned to have these trains in production and reaching speeds in excess of 350 mph.

Future computers could be composing music and poetry, cleaning the house and replacing politicians!



MAN'S RIGHT-HAND MACHINE OF TOMORROW

COMPUTERS Part 4

Over the past three weeks we have seen how the computer was born, how it works, its advantages and shortcomings, and its present uses. What we have to ask now is what exactly the computer is going to do to our future world once scientists have mastered its electronic 'teething' problems.

One brilliant computer scientist, Dr. Warren McCulloch, put forward a view when he said: "The brain is like a computing machine, but there is no computing machine like the brain." And he and others go on to discuss the fear of many that machines will one day replace Man—the theme that has been explored by so many science-fiction writers.

It's just the speed of the computer that gets us confused. Its copper wires carry currents at a speed of about 186,000 miles a second, whereas currents in human nerves travel only about 100 yards in the same time.

Electronic Brain

However, examine the 'circuits' in a human brain the size of a child's ball. There are said to be *ten thousand million*. Inside a computer the size of a room, it has so far not been possible to put more than 100,000 transistors.

Man's brain then is phenomenally superior but, shall we say, slow, disorganised and haphazard. The 'electronic brain' is

In a television programme on pollution in Germany, a computer was used to correlate the opinions phoned in by viewers and a panel of experts on the problems raised during an organised discussion. The experiment produced new ideas and questions that "experts" in the studio admitted they might never have thought about.

inferior, but in those areas where its development has been perfected, it is much faster and more efficient than humans in every way.

However, with our high-speed improving 'imitator' of the human brain, what can we expect next?

Get used to the idea that one day we shall

actually be able to *speak* with our computers. Experiments are already under way, and within 20 years direct communication by microphone and loudspeaker between man and machine may be possible, as opposed to the streams of punched tape that roll in and out of the enormous calculators.

The robot, of course, is already with us,

but will become more 'human', if we dare use that term. In America, experimental work is progressing on robot cleaners that wander through the home, move the furniture gently, clean it, polish the floors, move to the disposal unit, empty their dust and refuse, put themselves back into their cupboard and 'feed' themselves with instructions for some other kind of work—maybe even 'reading' a book to help the son of the house with his homework later.

The housewife one day will even be able to telephone her robot and tell it to do the shopping, prepare a certain meal, switch on the automatic washing machine and so on. It will become the labour-saver extraordinary.

War, famine and natural disasters have always been with us, but even the effects of these could be altered dramatically by the computer.

Chess problems can already be stored and worked out by the 'electronic brain', and similarly the strategic moves of war will be organised. Details of all the world's most decisive battles will be fed into computers—indeed many already have been—and all the tactical moves that led to victory will be stored, ready to be selected in any number of combinations, in the event of another war breaking out.

Disaster Relief

In cases of natural disasters, computers will be able virtually to predict where they will occur, from data accumulated from study of past disasters and from information regularly coming in from current scientific observation. At the same time, computers will be planning the means of best relieving the sufferers, designing the most efficient safeguards and deciding where relief funds will serve their best purpose.

The actual government of nations most probably will be determined by the computer of the future. At present, as always, countries are governed by politicians, not all

of them, sad to say, extremely clever, far-seeing, fair or efficient.

It is possible in future that important decisions will not be left only to the politicians, but that the attitudes of every responsible person in the country could be virtually 'phoned' into a central computer which would then 'propose' a course of action that was favoured by the country as a whole.

A similar instant 'national debate' was tried in West Germany last year. Scientists discussed pollution on TV, while open telephone lines connected viewers to the studios. As each problem was raised, opinions of viewers were phoned in, processed in a computer while the discussion continued, and then influenced the discussion as it took place. The experiment produced new angles and variations of thought on the matter that the 'experts' admitted they might never even have considered otherwise.

What about art—music, poetry, literature, philosophy? Yes, they're on the way. 'Poetry' has been written by computers and 'music' has been composed by them. Though it is hardly stuff that stirs the soul yet.

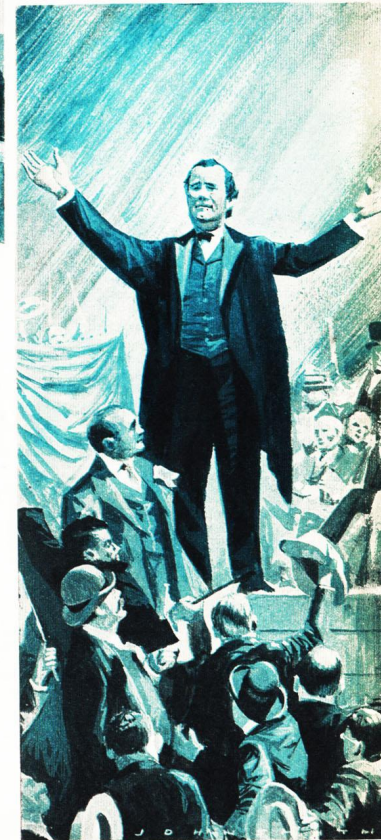
Monotonous Music

The *Illiac Suite for String Quartet* was composed by a computer which—basically—had been fed melodies and different musical styles and then told to arrange them in mathematical progressions. Some of its tries were terrible apparently, but it did produce a work in the end—a work that critics tend to regard as too monotonous to be pleasing.

Who knows what a computer will one day 'create'?

When it comes to philosophy and great thought, exciting possibilities lie ahead. Computers could possibly analyse the minds and methods of the world's great thinkers and artists—the Einsteins or the Picassos—and store the facts away for posterity. Thus one day, if the world had a problem, there would be no need to say, "Oh, if only Einstein were alive today".

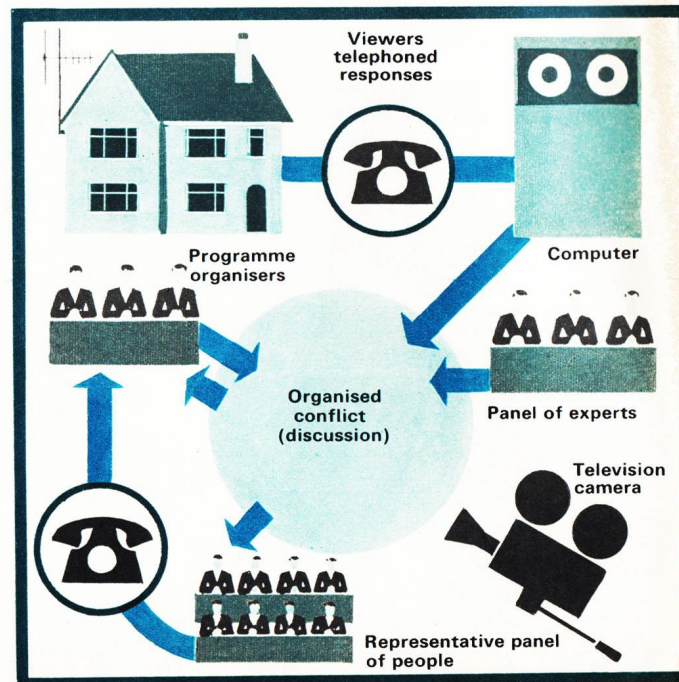
In a sense, he would be. The computer could be asked what his most likely course of behaviour would be if confronted by a certain problem.



It is possible that in future important decisions will not be left only to politicians, but that the opinion of every responsible person in a country could be "phoned" into a computer that would decide a course of action that was favourable to the majority of people.

Another interesting thought has been put forward—that if thousands of programmers assembled all the present known knowledge of Man and spent tens of years feeding them into computers, we might actually be able to foresee how Mankind is likely to develop and take steps to correct human faults that are developing now and will be drastic in, say, 10,000 years' time.

Such possibilities, however, are far, far ahead. Even so, be prepared for the amazing, the unusual, the humorous and the disconcerting from these mechanical minds—and you will eventually learn to live with and love the Computer Age!



When Two Hulls Are Better Than One

Catamarans, trimarans—we are hearing more and more of these ingenious craft. Yet it all started centuries ago when a primitive people thought of joining two log canoes together

The great advantage offered by the three-hulled trimaran as a cruising boat is its spacious accommodation (see sketch below).

The word "catamaran" comes from two words in the Tamil language of Southern India: *kattu*, meaning "bind", and *maram*, "wood". Inhabitants of the coasts in that region use two or more log canoes, tied together but held apart by a rigid structure of wood, to reduce the risk of capsizing in rough waters.

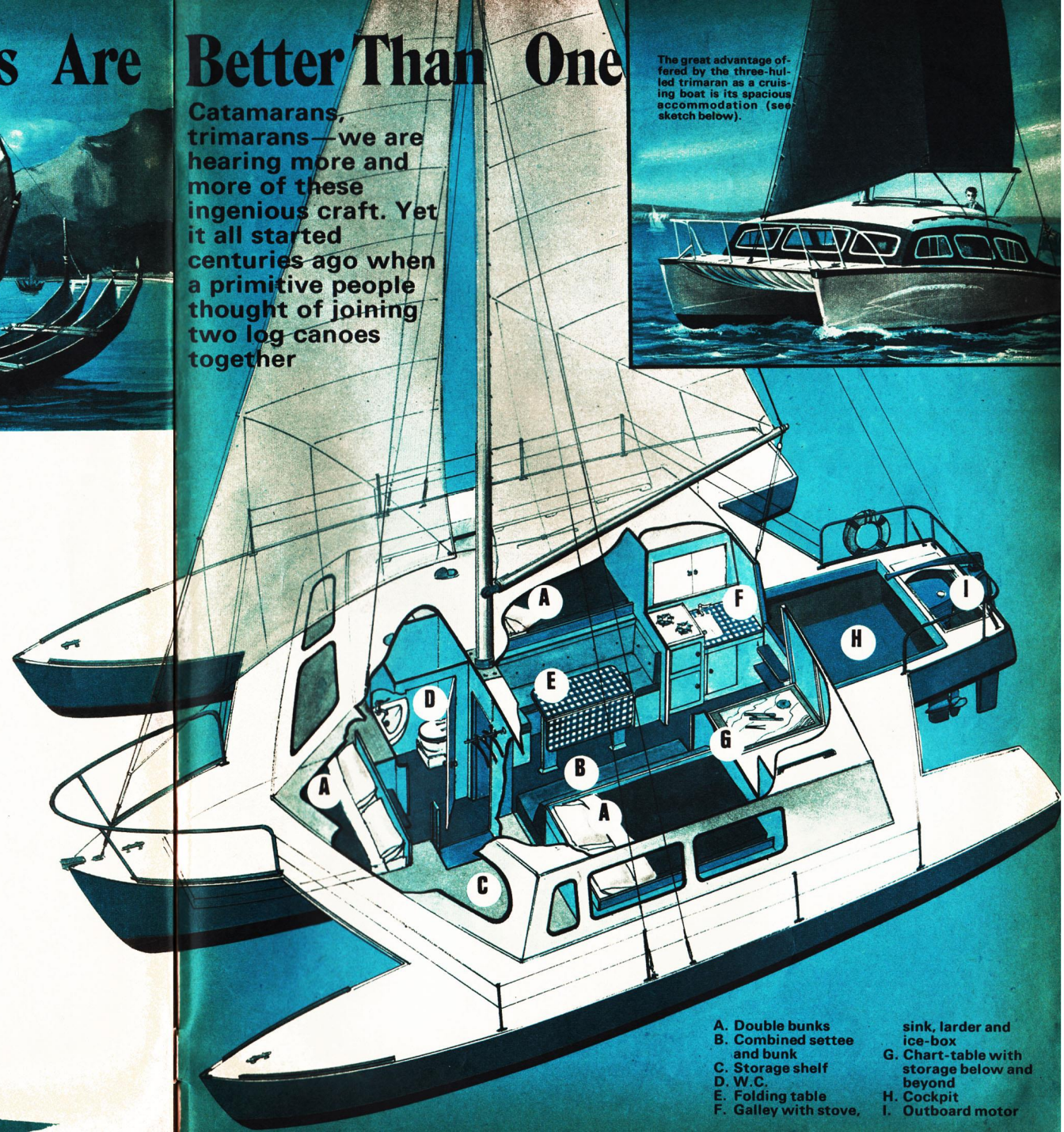
As developed in different parts of the world, the catamaran has varied, from a craft consisting simply of a canoe with an outrigger attached for stability, to boats having two or more actual hulls. Some of the most famous examples are to be found in Polynesia, in the Pacific Ocean. Many of these craft were seen by Captain Cook during his 18th-century explorations, and paintings by artists who travelled with him can be seen in the Maritime Museum, at Greenwich, London.

The illustration above shows a twin-hulled fishing canoe of Tahiti, and a large ocean-sailing catamaran of the type in which the Polynesians are known to have migrated from island to island.

Modern racing "Cats" are very fast, and when racing against conventional yachts will nearly always win. The yacht needs a deep keel to balance the mast, and this, together with the wider hull shape, creates resistance to its progress through the water. The hulls of the catamaran skim across the top of the water. Most are, however, fitted with small keels or centre-boards. Recognised British designs of racing catamarans are the Shearwater, Swift and Mercury.

While some twin-hulled catamarans are fitted as cruising boats, the "trimaran" with its three hulls really comes into its own for accommodation space. Shown here in the cutaway sketch is a 6-7 berth cruising trimaran. This type of craft is usually fitted with an outboard engine for use in harbours.

Catamarans have amply proved themselves as racing craft. They are generally too fast for yachts with conventional hulls.



- A. Double bunks
- B. Combined settee and bunk
- C. Storage shelf
- D. W.C.
- E. Folding table
- F. Galley with stove, sink, larder and ice-box
- G. Chart-table with storage below and beyond
- H. Cockpit
- I. Outboard motor

Once upon a time . . . barges travelled by sea under their own steam. But a new idea from America means that in future all that could change

WONDERWORLD OF SCIENCE



Here we see how the pusher tugs slide the barges on to the lift so that they can be raised and manoeuvred on the various decks.

SHIP-LOAD OF BARGES

Since the days when ships first crossed the seas, cargo had been loaded on board and stowed in the holds in much the same way. The only difference was that as ships became bigger and the docks they used became larger, heavier and bulkier loads could be transferred from shore to ship.

Then came the oil tanker, the cargo of which could be pumped on or off the ship in a few hours. Later, similar vessels, called bulk carriers, were used for the transport of ores and wheat.

More recently, the container ship was introduced. The container ship's cargo is packed into huge boxes holding as much as 50 tons and then sent by road or rail to the docks. There it is lifted into the ship by powerful and specially-built cranes.

But whatever the type of ship, it can load or unload only where there is a harbour with deep water and docks equipped with cranes and other cargo-handling machinery.

To provide enough depth of water for big ocean-going ships, harbours and docks have to be on the coast. It is only where there are rivers or canals deep enough to take big ships that docks can be any distance inland.

Loading or unloading a ship, whether at a large coastal or inland port, is a slow business. With the exception of tankers and bulk-carriers, the amount of cargo that can be lifted on or off the ship is strictly limited by the power of the cranes.

Even with the most up-to-date handling equipment it takes over a week to load or unload a freighter with 25,000 tons of cargo. According to shipping experts, the average big, ocean-going freighter spends at least a quarter of its working life in dock loading or unloading.

First of a Fleet

To cut the time wasted in loading and unloading and to make cargo ships independent of ports and their costly handling equipment, the Lykes Steamship Company of New Orleans launched the *Seabee* last July. It is the first of a fleet of four ships which will be quite unlike any other freighters now at sea.

The *Seabee* is 875 feet long, 106 feet wide and is driven by engines of 36,000 horse-power to give it a speed of 20 knots. It can carry 34,000 tons of cargo which can be loaded or unloaded in 12 hours.

And that huge amount of cargo can be put in the ship or taken out of it without the use of dockside cranes or other lifting equipment on shore. In fact, the *Seabee* does not even need a dock.

Provided the water is deep enough, the *Seabee* just anchors in a river or estuary or, if the weather is not too rough, anywhere off the coast. The cargo is then brought out to her in barges which are lifted into the ship.

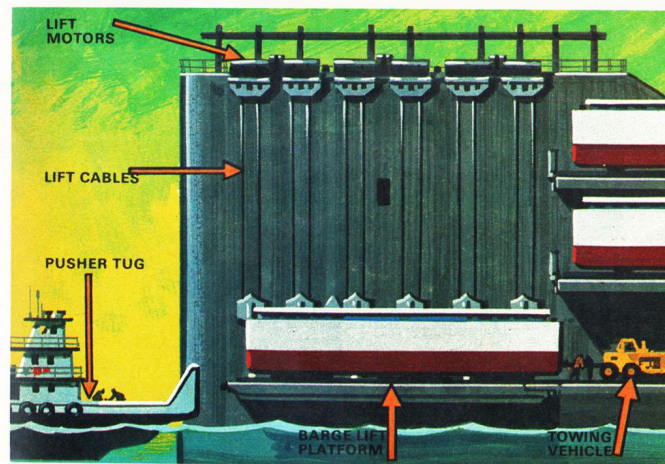
Stern Lift

Five hundred special barges have been built to serve the fleet of four *Seabees*. Each barge is 97 feet long, 35 feet wide and can carry up to 400 tons of cargo. At the bottom of every barge there are four wheels.

When the barges have been towed towards the *Seabee* ship, a special tug takes over and pushes each one towards the ship.

In the stern of the *Seabee* is an enormous electrically-operated lift which can raise two fully-loaded barges.

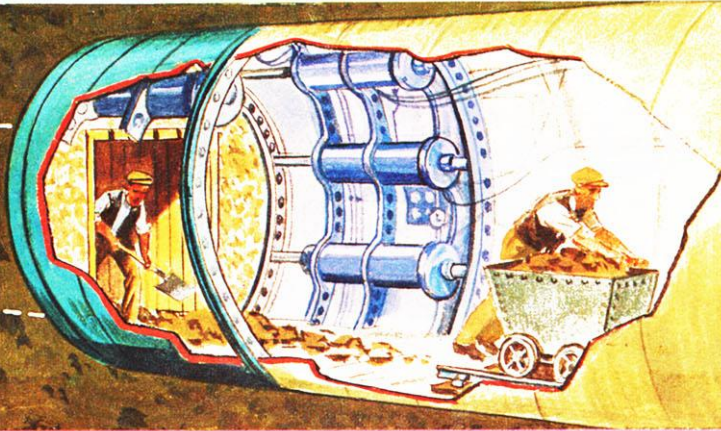
The tug pushes the barge on to the platform of the lift, which has been lowered ten feet below the surface of



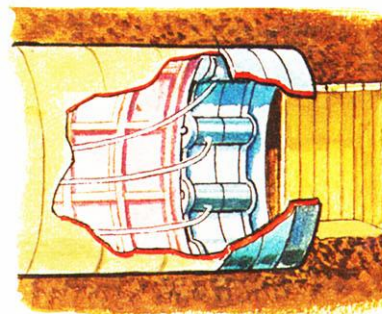
MECHANICAL MOLES

THE STORY OF TUNNELS Part 4

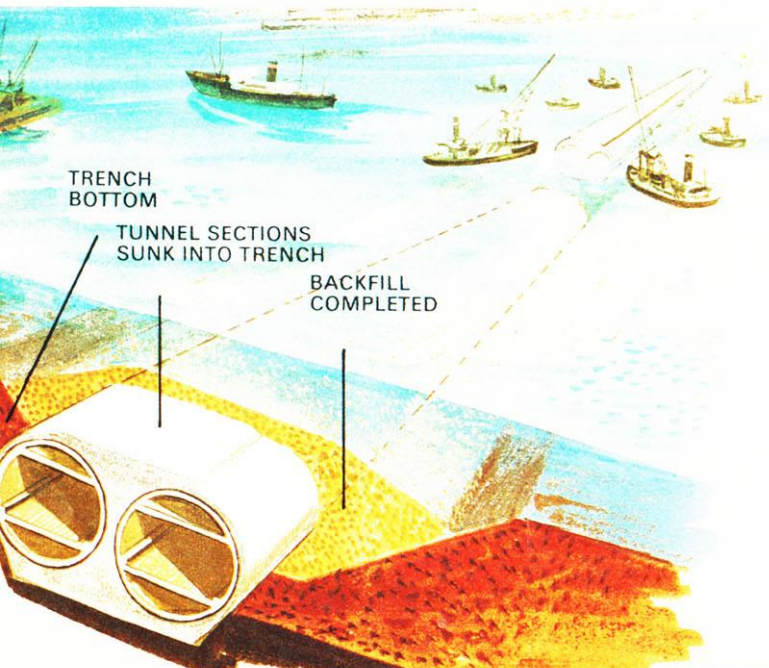
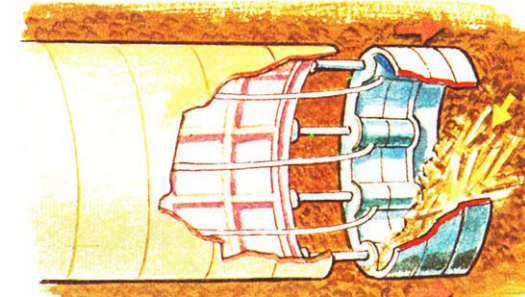
Last week we left the first tunnel under the Alps, the Mont Cenis or Fréjus Tunnel, being built by the great engineer, Germain Sommeiller. It was he who pioneered the use of pneumatic drilling, a tremendous advance on pick, shovel and sweat, though there was plenty of need for all three still, and gunpowder as well. When the first train went through the completed tunnel in 1871, Sommeiller had, like many tunnellers before him, died of overwork.



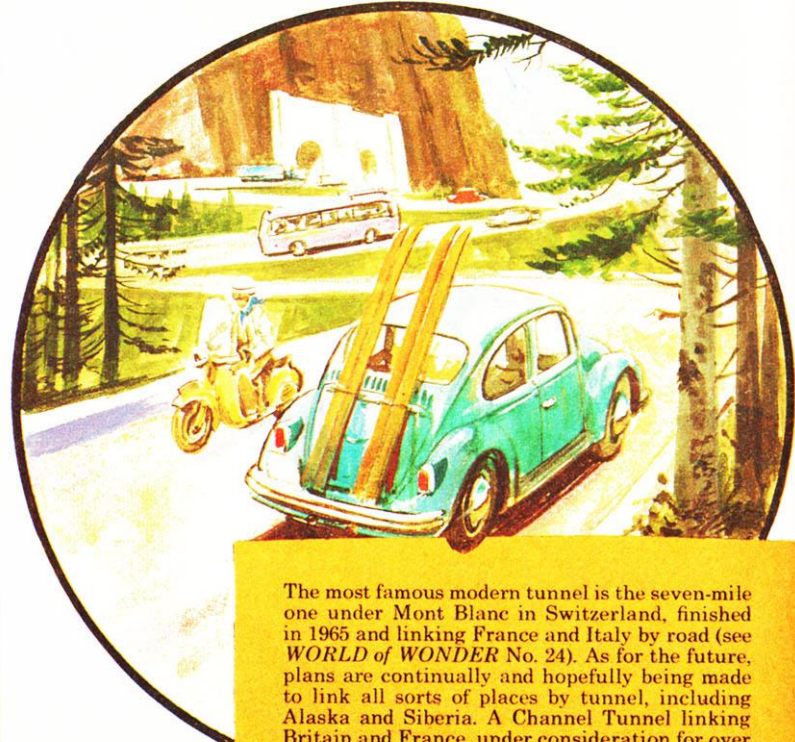
Meanwhile, another step forward had taken place. A South African named James Greathead had improved on Brunel's shield, which we saw two weeks ago, and invented a steel cylinder. He used it first for a tunnel under the Thames, and from the 1880s onwards London's underground railway builders made maximum use of the shield, which is still basically the same today.



The shield, pushed by hydraulic jacks, moves forward in "shoves" of about two feet at a time, while in the front part of it tunnellers dig out earth. After each push forward another length of permanent lining of concrete is erected in the rear of the cylinder.



Above you can see how a modern tunnel can be sunk in sections, as the Baltimore harbour tunnel in America was. This 7,650-foot double tunnel carries four lanes of traffic. Underwater tunnels more often use the shield system or compressed air. With this latest method the pressure of water is kept back by compressing air where work is going on. As the air pressure in the tunnel is more than the water pressure outside it, the water cannot get in.



The most famous modern tunnel is the seven-mile one under Mont Blanc in Switzerland, finished in 1965 and linking France and Italy by road (see *WORLD OF WONDER* No. 24). As for the future, plans are continually and hopefully being made to link all sorts of places by tunnel, including Alaska and Siberia. A Channel Tunnel linking Britain and France, under consideration for over a century, may at last be constructed.

(The End)

One Way To Sail Up A Hill

Soviet engineers decided to build a new canal in Siberia for barges and ships to carry coal and iron ore to a large steel-works. But they were faced with a serious problem.

Provided a canal can be cut through flat country, it is far cheaper than road and rail transport for the carriage of freight. But where the route of the canal is not across flat country, the ships and barges using it have to be lifted up or down from one level to another by means of locks.

Not only are locks very costly to build and to operate, but a lot of time is wasted by ships and barges waiting to use them. Sometimes the building of locks can be avoided by cutting the canal through a route that by-passes rising ground by going round it. In that case the canal has to be much longer and costs more to build, and the vessels using it take longer on their journey.

The route of the new Siberian canal included a two-mile stretch of ground which sloped upwards to a height of nearly 300 feet. To have by-passed the slope by curving the canal around it would have meant adding nearly 40 miles to the length of the canal.

So the Russian engineers solved the

Why bother with those cumbersome, old-fashioned canal locks, when a "tank-on-wheels" will do the job just as well and twice as quickly?

problem of keeping the canal to its originally designed route by building the canal in two parts and joining them with a railway to carry vessels up and down the slope.

The first half of the canal ended at the bottom of the slope and the second half began at the top of the slope. A sloping concrete ramp was built to link the two halves of the canal.

Along the ramp two sets of track were laid, like railway lines. These continued into a dock at each end of the ramp.

Barges and small ships arriving at the lower level of the canal move into a dock where they are manoeuvred into a huge tank of water weighing 5,000 tons. The tank is mounted on 40 six-wheeled bogies, and can carry one barge or ship of 1,350 tons or four 350-ton barges.

There are two of these tanks on wheels. One is for taking ships up and the other is for bringing them down.

The tank containing the vessels is hauled up the track on the ramp by six steel cables. The cables are wound on a huge steel drum driven by four electric motors.

Current for the motors is generated by dynamos driven by water flowing from the upper section of the canal down a pipe to a power station at the lower level of the canal.

When a tank arrives at the top of the ramp it moves into a dock. Heavy steel doors in front of the tank then open and the vessel or vessels float out into the upper section of the canal.

After the vessels have moved out of the tank, ships or barges wanting to get to the

WONDER WORLD OF SCIENCE

lower half of the canal enter and the doors are closed. The tank then starts on the down journey.

By having two of the huge tanks on wheels, a constant up and down service is ensured. A ship can be moved between the two canal levels in 30 minutes.

At the top of the ramp there is a high tower on which a control-room has been built. Simply by pressing buttons on a control-panel an engineer can start and stop the tanks, open the doors when the tanks are ready to take in a ship or barges, and close them for the journey up or down the tracks.

The engineer can see every movement of the tanks on closed-circuit television. If anything goes wrong he can stop one or both tanks simply by turning a switch to cut off the current to the motors driving the drums.

In the event of a power failure stopping the drums or of the cables breaking, brakes on the tanks come into immediate action and stop them from sliding down the ramp.

Russia's ship-railway took two years to build and cost £15,000,000. But the cost was well worthwhile, as it reduced the length of the canal by 40 miles and cut the time of journey between the two points by eight hours. Also fewer ships and barges are needed, as each vessel is able to make more trips.

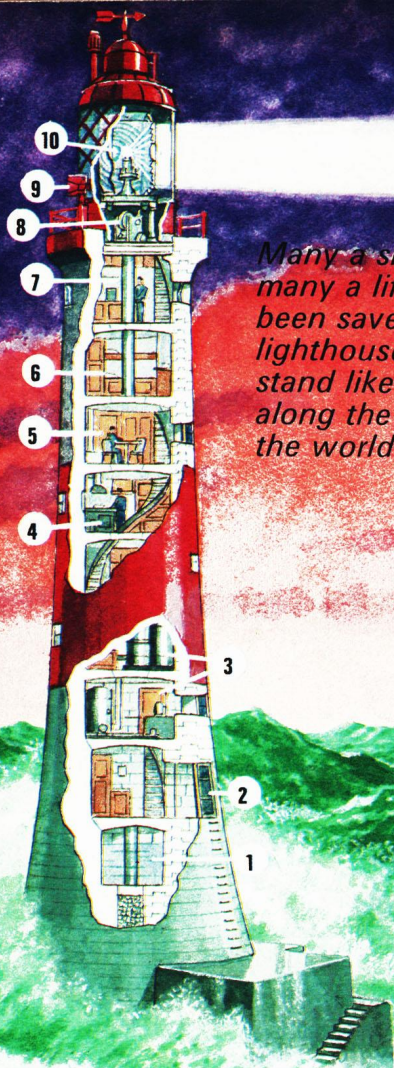
One of these ship-carrying tanks prepares to descend with a ship, while the other is about to unload its barges into the upper dock. The control-tower rises above the dock entrance.

A closer view of one of the mobile tanks, with an ore-carrying ship afloat in it. Electric light on the gantries permits work to continue at night.

The view from the top of the "ship railway", showing barges that have just made the ascent, while others wait for a mobile tank to come and take them down.

LIFELINES OF LIGHT

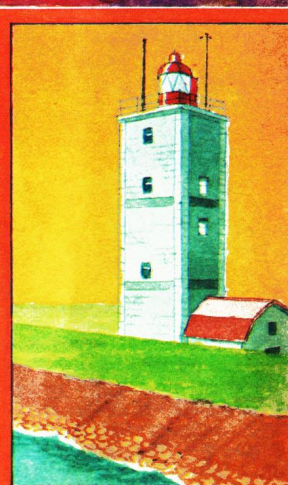
MACHINES AT WORK



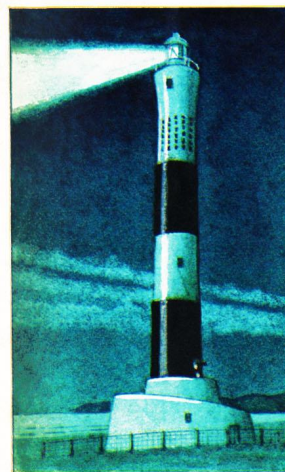
Many a ship, and many a life, have been saved by the lighthouses that stand like sentinels along the coasts of the world



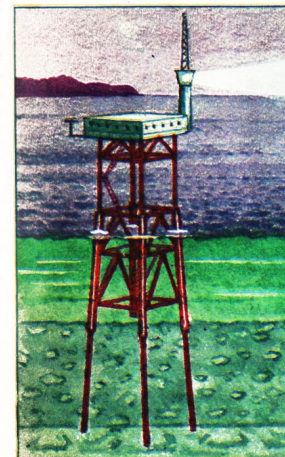
A lighthouse consisting of a steel cylinder, sunk into sand and filled with concrete. The Rotherham Light-house in the River Weser, West Germany.



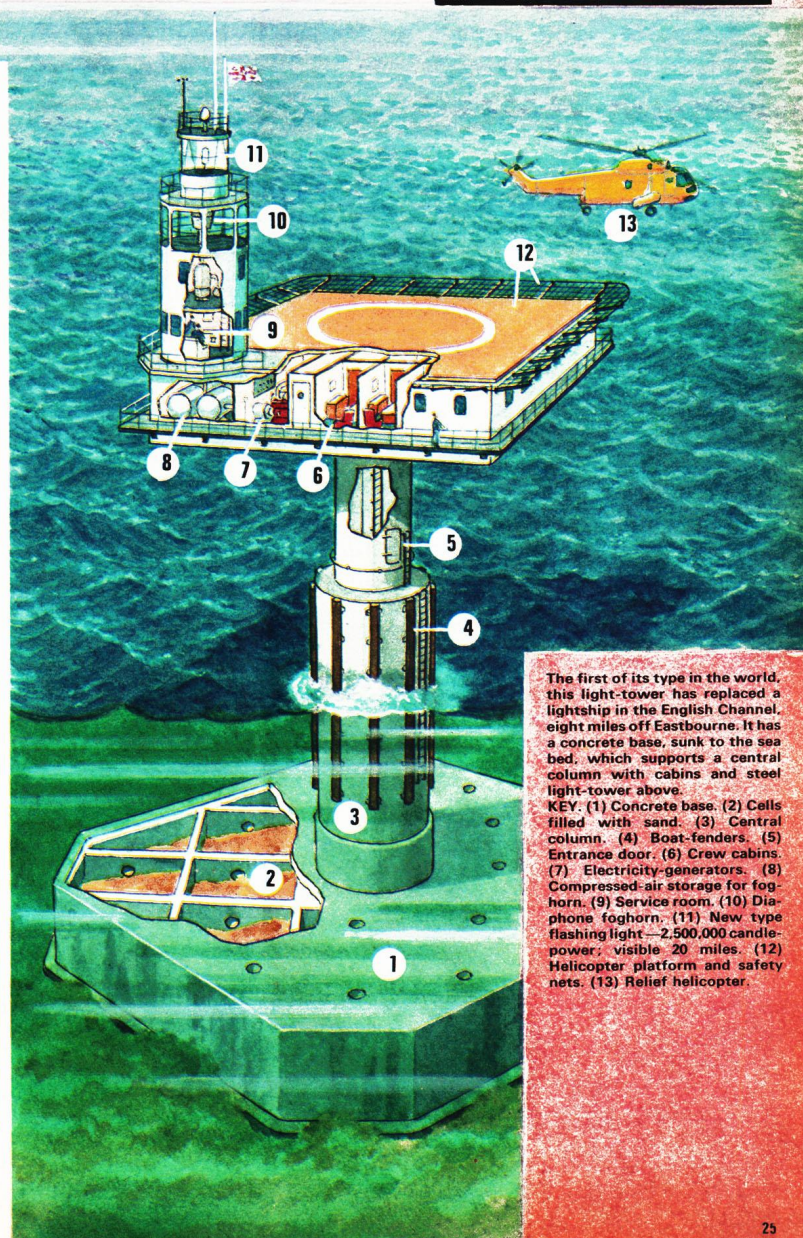
This Dutch lighthouse in the Netherlands is built behind a dyke on a polder—a low-lying area of land that has been reclaimed from the sea.



Shore lighthouse at Dungeness, Kent; one of the most modern in the world, with the latest gas-electric lamp, and "built-in" fog-signal emitters audible eight miles away.



Offshore pile-type lighthouse anchored into rock 200 feet below sea-level, with helicopter platform; Buzzards Bay Light Station, Massachusetts, U.S.A.



The first of its type in the world, this light-tower has replaced a lightship in the English Channel, eight miles off Eastbourne. It has a concrete base, sunk to the sea bed, which supports a central column with cabins and steel light-tower above.

KEY: (1) Concrete base. (2) Cells filled with sand. (3) Central column. (4) Boat-fenders. (5) Entrance door. (6) Crew cabins. (7) Electricity-generators. (8) Compressed-air storage for fog-horn. (9) Service room. (10) Dia- phone foghorn. (11) New type flashing light—2,500,000 candle- power; visible 20 miles. (12) Helicopter platform and safety nets. (13) Relief helicopter.

A typical lighthouse built on a rock and constructed of interlocked granite blocks.

KEY: (1) Fresh-water tank. (2) Entrance door. (3) Lower and upper oil-room. (4) Kitchen. (5) Living room. (6) Bedroom. (7) Service room for lamps, etc. (8) Clock-work mechanism for rotating the light. (9) Foghorn. (10) Brilliant white oil light surrounded by revolving optical lenses giving a beam of 700,000 candle-power. Light visible 18 miles, and flashing every few seconds.

When on holiday at the seaside you have no doubt stood by the shore and watched little points of white light flashing their message to ships that pass in the night. Lighthouses, whether built on lonely, wave-swept rocks or perched on cliffs, are still, despite the great developments in radio, beacons which are essential to the safety of ships.

The Pharos of Alexandria (see *WORLD of WONDER* No. 22) has been described as the "father of lighthouses" and was built long before the birth of Christ; and since then

they have developed in efficiency over the centuries. They existed in many parts of the Roman Empire.

Examples of various types of lighthouses are shown on these pages—the older ones on the left, the modern ones on the right. Some older ones used oil lights, but more and more have now been electrified. Modern gas-electric lamps have been developed of over three million candle-power. Light-houses equipped with radio beacons now enable ships to take bearings whatever the weather conditions may be.

WORLD of WONDER

EVERY MONDAY : PRICE 10p : No. 132 ; 30th SEPTEMBER 1972

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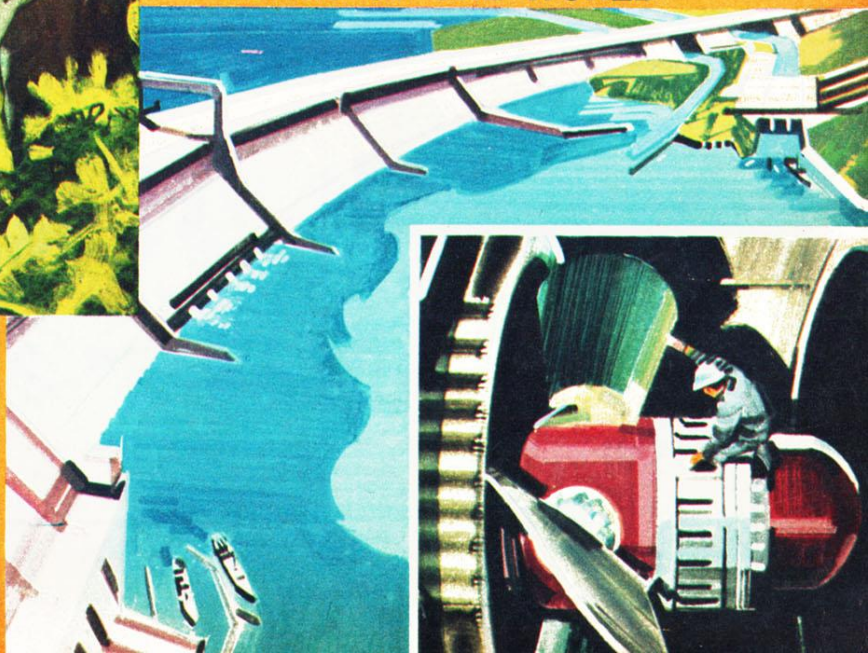
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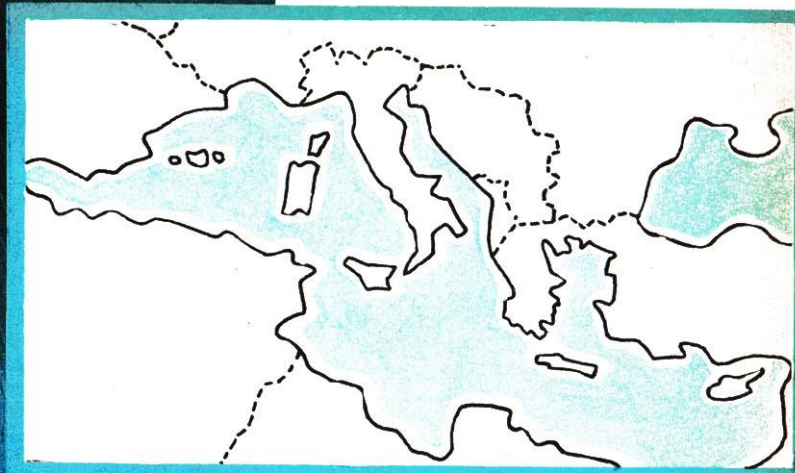
A special adaptation of Mark Twain's rollicking fun-packed story

**A YANKEE AT KING
ARTHUR'S COURT**

AND a look at a new scheme put forward by experts to

GET RID OF THE MEDITERRANEAN!





SHOULD WE DRAIN THE MED?

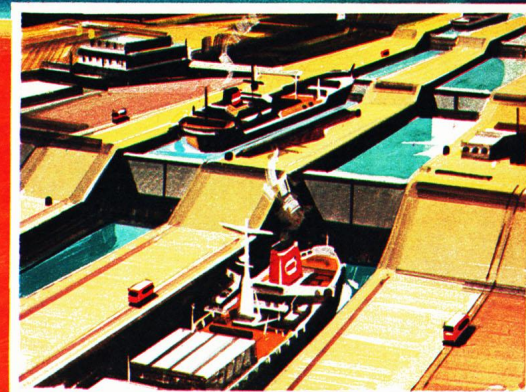
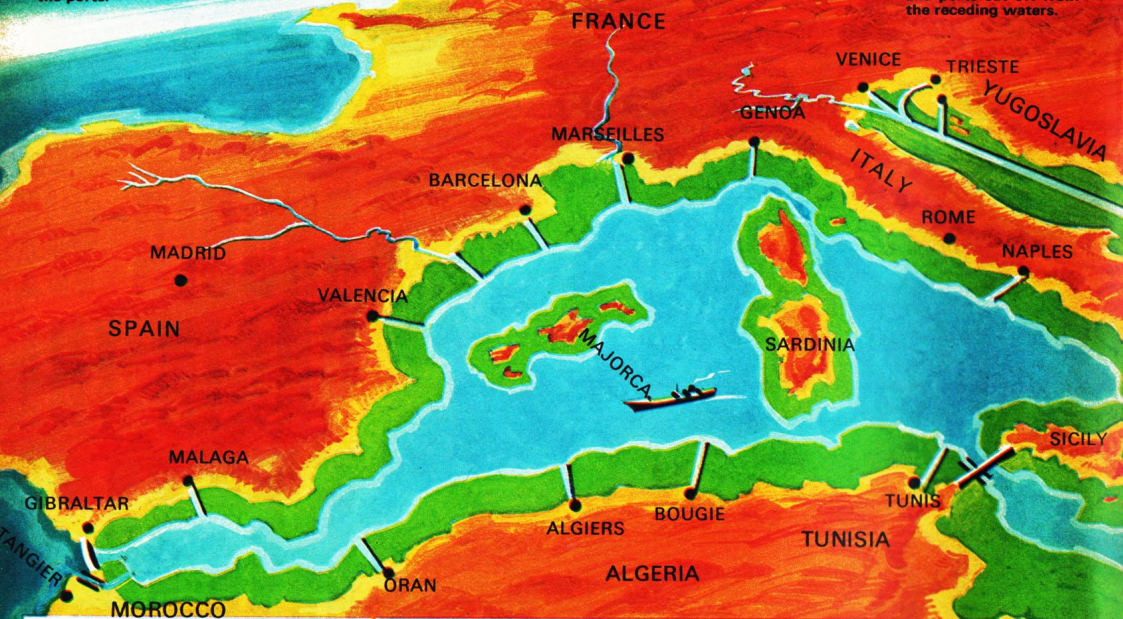
The Mediterranean Sea, Mecca of millions of holiday-makers, is the target for one of the world's most ambitious projects

Get rid of the Mediterranean! That is the sweeping plan advanced by a group of civil engineers who claim that by blocking the Strait of Gibraltar, the water of the Mediterranean would gradually evaporate, making an area of over a million square miles of land available as valuable agricultural land.

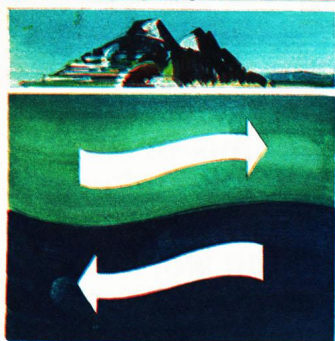
The carrying out of this plan would help to solve the increasing problem of feeding the world's expanding population,



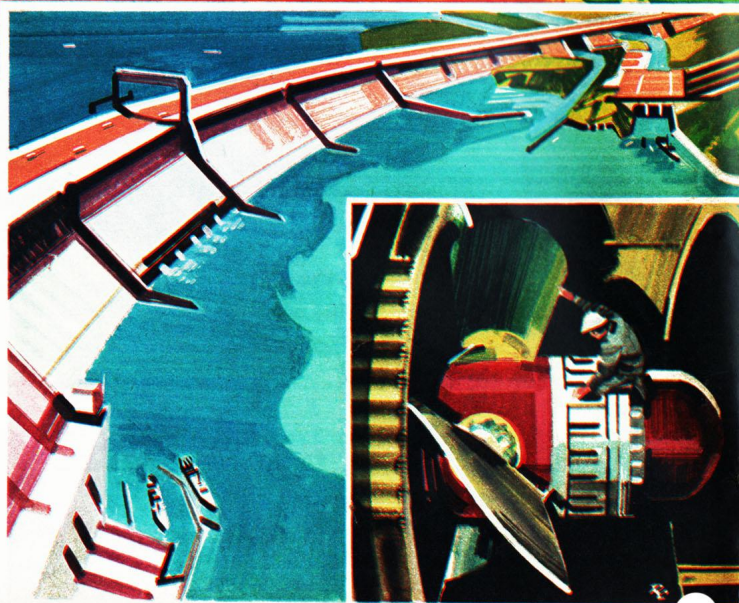
Here we see how the Mediterranean might look if it were partially drained. The present coastline would be separated from the sea by reclaimed areas (coloured green), and canals giving access to the ports.



A smaller dam between Tunisia and Sicily would divide the Mediterranean into its original two lakes. Pictured above is a three-tiered lock system which could be used with such a dam.



The diagram shows the sea-current flowing eastwards into the Mediterranean through the Strait of Gibraltar, and the colder stream of heavier, saltier water flowing westwards at a greater depth.



An impression of the Gibraltar Dam as it would appear from the Mediterranean side. Inset: giant turbines, with adjustable and reversible blades. Turbines of this type would be required to harness the movement of water at the dam for the generation of electricity.

One day the name Mediterranean may disappear—to be replaced with the word "Atlantropa"

and would bring other benefits, such as a warmer climate for countries bordering the North Sea.

In fact the Mediterranean (so-called because the Ancients regarded the area as the middle of the Earth) has not always been in the form it presents today. Geologists declare that long ago it consisted of two big lakes at a level lower than the present Mediterranean.

The reclamation idea is not exactly new, either. Hitler was enthusiastic about it, and he boasted that it would be carried out as part of his plans to change the face of the Earth, after he achieved his aim of defeating the Allies in the Second World War.

The possibility of closing the Strait of Gibraltar was closely examined by Hermann Soergel, a German architect, and has had the attention of other experts

since the end of the War. According to their calculations, the Mediterranean would dwindle in depth at the rate of 5 feet 2 inches a year if the supply of Atlantic water were cut off.

Although the process would be slow, by the year 2070 a total of 90,000 square miles of new land would become available. Obviously, ports existing today along the Mediterranean coastline would be made obsolete, but their loss would be more than offset by using the reclaimed territory for crops of various kinds.

Also to be borne in mind is the fact that the basin of the Mediterranean is lower than the bed of the Atlantic. As a result, some six million cubic yards of water sweep eastwards through the Strait every minute.

Stemming this tremendous surge would be the biggest engineering opera-

tion so far tackled anywhere in the world. Yet engineers are confident that it could be done today, by using techniques developed during recent years. We have already mastered the difficulties of erecting structures well out to sea, and experience gained in this way could be applied to plugging the gap near Gibraltar.

To withstand the immense pressure of the sea, the dam would not be built in a straight line across the Strait, but would arch out into the ocean.

The structure would be 500 yards thick at its base, to resist the Atlantic currents and waves, and would taper gradually to 50 yards at the top.

Geographic and oceanic surveys have revealed that, while the depth of water at the narrowest part of the Strait is more than 1,500 feet, there is shallower water



What your Mediterranean holiday resort may look like if the sea is allowed to shrink. The former sea-front is now marked by the line of a canal.

nearby. And a series of rocks in the vicinity would serve as "stepping stones" for the dam.

A smaller dam would be needed to close the Dardanelles between the Mediterranean and the Black Sea; and a number of European rivers which flow into the basin would have to be diverted. Engineers see no insurmountable problem here. The Dardanelles dam will be necessary because the flow from the Sea of Marmara and the Black Sea normally constitutes about one-tenth of the water reaching the Mediterranean basin.

A curious feature of the Mediterranean is that its water is more salty than that in the open seas of the world. Another oddity is that while water from the Atlantic is flowing eastwards past Gibraltar, another and colder stream flows in the reverse direction at a lower depth.

This cold water tends to cool the warm Gulf Stream, the ocean drift that flows westwards across the north Atlantic. It also diverts it, so that it does not reach Europe directly. Closing the Strait of Gibraltar would probably cause the Gulf Stream to flow directly into the English Channel and the North Sea. The climate of the British Isles and other countries bordering the North Sea would thus be enhanced.

A further benefit derived from the dam

Where once you bathed or steered your pedalo, tractor and plough may till new fields

would be the ability to harness the vast power of the Atlantic waves. Driving against the dam, their force could run electricity generating stations. This major source of electric power would be of immense importance to the developing countries of North Africa.

Another scheme for the Mediterranean envisages draining only part of the area, leaving ample water for shipping, but lowering the water level to such a degree that the shrinkage creates a belt of new land all round the coast.

A deep canal with locks would by-pass the Gibraltar dam, so that ships could reach the open sea. Ports left high and dry as a result of the changes, such as Barcelona and Malaga, in Spain, would be provided with artificial waterways connecting them with the smaller sea.

Some authorities suggest that the inland sea should be reduced in stages, at

intervals of about a century. After all, Europe and Africa were once joined together by three isthmuses—one from present-day Spain to Morocco, one from Italy and Sicily to Tunisia, and another from Greece across the eastern end of the Sea as we know it today.

The experts backing the schemes do not expect them to materialise overnight. Many national and international interests are involved—not least those of the tourist trade, and all its clients who look forward to a seaside holiday.

But civil engineers are sufficiently convinced of its practicability to have already given a name to the Mediterranean of the future.

They call it "Atlantropa".

And that is the name which the map-makers of tomorrow may apply to this region which was once thought to be at the centre of the world.

ANSWERS TO

WHAT DO YOU KNOW?

1. Spend it. It is an old Spanish coin.
2. The Ten Commandments.
3. (a) stubborn; (b) flat.
4. Lord Byron (1788–1824).
5. St Alban, in the 4th century.
6. The ounce.
7. The rings were an anti-magnetic mine device which enabled the RAF to blow up German mines safely from the air.
8. The Khmer Republic.
9. A portcullis.



LEADERS of the 20th CENTURY

RUSSIA'S MAN of STEEL

Joseph Stalin was the dictator-premier of Soviet Russia for 24 turbulent years. The name "Stalin" means "Man of Steel", and that he certainly was, for he held his nation in a grip of steel that crushed all opposition.

However, it can be said that his ruthlessness was, in a way, justified. When he came to power Soviet Russia was a new republic, recently born out of revolution and civil war. The country was devastated and disorganised, and famine brought a great hunger.

Stalin was indeed an unrelenting taskmaster, but his harsh methods forged the Soviet Union into a great power.

He was born in 1879 in Georgia, South Russia, the son of a shoe-maker. His real name was Joseph Djughashvili. In those days Russia was ruled by a Tsar, or Emperor, whose word was law, and his government consisted of aristocrats and privileged people.

The millions of peasants and workers lived a hard and miserable existence. So men like Lenin, Trotsky, and Stalin rebelled and worked towards a revolution that would sweep away the Tsarist system and bring about a republic in which the land and factories would belong to the people.

It was during these early years of secret revolutionary activity that Joseph Djughashvili adopted the cover name of Stalin, which he kept for the rest of his life. He was arrested by the police and exiled to Siberia, but he escaped. He was caught and sent back to Siberia. When the Revolution finally came in November 1917, Stalin was still in captivity.

Years of Bitter Civil War

He was brought back from exile and became a senior member of Lenin's Bolshevik party. When Tsar Nicholas II abdicated immediately after the Revolution, a provisional government under the liberal Alexander Kerensky was set up. Lenin was opposed to this form of government and seized power by force from Kerensky, who then rallied an army to fight the Bolsheviks.

A crucial battle was fought outside Petrograd, the capital, in which Stalin led a regiment of ragged but determined factory workers, who played a major part in defeating Kerensky's army. There followed three years of bitter civil war.

When the victorious Bolshevik government, under the leadership of Lenin, became firmly established, Stalin was given an important post. He was an efficient organiser with a thirst for power. After the Bolshevik party became the Communist Party, the controlling machine of Soviet Russia, Stalin became the Secretary-General of the Central Committee of the Party.

Lenin died in 1924, and a struggle for supreme power developed between Stalin and Leon Trotsky.

Stalin was a ruthless intriguer, cold and cunning. As Secretary of the Communist Party he quietly established his hold on all the key posts in the government. In 1929 he brought about Trotsky's expulsion from the Party and his banishment from Russia.

The Man of Steel was now undisputed master of Russia. He soon launched his first Five-Year-Plan to revolutionise industry and agriculture, a kind of crash-programme of advancement.

To maintain his power Stalin made Soviet Russia into a police state. Those who raised their voices in protest against his harsh system were swiftly crushed. In the Great Purges of the late 1930s, Stalin had thousands executed.

Stalin never did trust the Western Powers, and in 1939 he signed a non-aggression pact with Hitler. But Hitler treacherously invaded the USSR in 1941, and Stalin made an alliance with Britain and America.

It was undoubtedly Stalin's firm leadership and forceful character



In 1943, the Allied leaders met at Yalta, in southern Russia. Our picture shows (left to right) Winston Churchill, Franklin D Roosevelt and Joseph Stalin.

that held Russia together under the tremendous German onslaught. A lesser, weaker man would have cracked under the pressure. Then the Russians, aided by large supplies of arms and equipment furnished by Britain and the USA, went on the offensive and drove the Nazi invaders back to Germany.

With the war over and victory won, Stalin resumed his natural hostility towards the Western Powers. By now many countries in Eastern Europe had Communist governments and were under Russia's influence. Stalin lowered an "iron curtain" to exclude Western influence and the "cold war" began.

Stalin's power never weakened until the day he died, on 6th March 1953. He was always presented as the infallible leader, the wise father figure of the nation. His body was embalmed and laid beside that of Lenin in Moscow's Red Square.

Three years later, however, Mr Khrushchev, the Soviet leader, made a speech in which he denounced Stalin as a brutal tyrant! This step was taken to show the dangers of letting one man rule the State.

Stalin, the discredited hero, was removed from the tomb in Red Square and put quietly elsewhere. A fresh, more liberal breeze, was beginning to blow through the Soviet Union.

Joseph Stalin, hated by some, hero-worshipped by others, stamped his ruthless personality on the history of his time



When Stalin died in 1953, his body lay in state in Moscow's Trade Union House, and was afterwards moved to the Red Square Mausoleum and placed near Lenin's. Later, after Khrushchev's denunciation of Stalin as an oppressor, the body was removed to a more obscure resting-place.



It's already a far cry from the days of Stephenson's Rocket—and this new sort of train will take us a long step farther

ROBOT ON THE RAILWAY

There seems no end to the new developments in railway engineering. Trains are already in service that can operate without guard or driver, though the latter is normally retained in case of emergency (see *WORLD OF WONDER* No. 123). But a new suburban railway system, expected to come into operation in Pittsburgh, USA, about 1975, will be entirely without crews.

The new system is called the Transit Expressway, and transport experts all over the world see it as the answer to the problem of providing fast and safe commuter services for large cities.

Several years of experiments with scale models have proved so successful that a full-size robot train is now being put through its paces on two miles of track on the outskirts of Pittsburgh.

Transit Expressway trains consist of coaches permanently coupled together in units of three, six, nine and twelve. Instead of the wheels being flanged to fit on steel rails, they have rubber tyres like those of a motor car and run on a concrete track.

A scale model of a train and station on Pittsburgh's projected "robot" suburban railway system. Inset: though there will be no crew on the trains, passengers will be able to report emergencies by radio-telephone.

Down the centre of the track there is a single steel rail to supply current to the trains' electric motors. The rail also keeps the train on the track. This is done by means of a pair of wheels with grooves which are fitted under the front and the end of each coach, with their axles at right angles to the floors. These wheels engage with a ridge on either side of the central rail and so keep the coaches running straight.

The concrete track and guide-conductor rail are laid across concrete pillars. These can be built over open country, down the centre reservation of motorways or along the sides of city streets. This will enable trains to run into the hearts of cities.

All the operations—stopping and starting the trains, accelerating or slowing them down—are remotely controlled through electronic equipment in the stations and at the lineside.

Computers at the railway's headquarters transmit electronic signals to the trackside and station equipment, and then to the driverless trains, by way of a cable laid along the side of the concrete track. Electric pickups on the trains collect the signals and convert them into short bursts of electric current. These in turn operate mechanical relays linked to the driving controls.



One of the driverless trains negotiating a curve on an experimental track.

The central computers store information sent to them automatically by every train running over the track network. All the time that a train is moving on the track or standing at a station, the electronic equipment on board is sending to the master computer its position, speed, and the exact moment when it enters or leaves a station.

The controlling computers then have to make split-second decisions based on this information. They then sort out all the information they receive and transmit the correct instructions.

Light Controls

At stations, the doors of the trains are kept open by means of an electromagnetic system, actuated by a photo-electric cell, as long as alighting or entering passengers interrupt a beam of light that is directed at the cell. When the beam remains uninterrupted for a specified number of seconds, the holding mechanism is released and the doors close.

The arrival and departure of trains is automatically timed, and their speed is so controlled that trains can run very close to one another without risk of collision.

In addition there is the safeguard that if there is any obstruction on the track or fault in the control system, all power in the affected section is automatically cut off, bringing all trains in the section to a halt.

On the illuminated chart at the central control-room, the position and movement of every train is represented by a green light. Should any kind of fault

occur on a train, the spot of light changes from green to red. If a fault occurs in the track, the exact position of the trouble is pinpointed by a yellow light on the chart.

Most faults on trains or track can be corrected by the human controller pressing appropriate buttons. Even such a trivial defect as a breakdown in a train's air-conditioning equipment can be instantly detected and reported, for repair when the train comes into the depot.

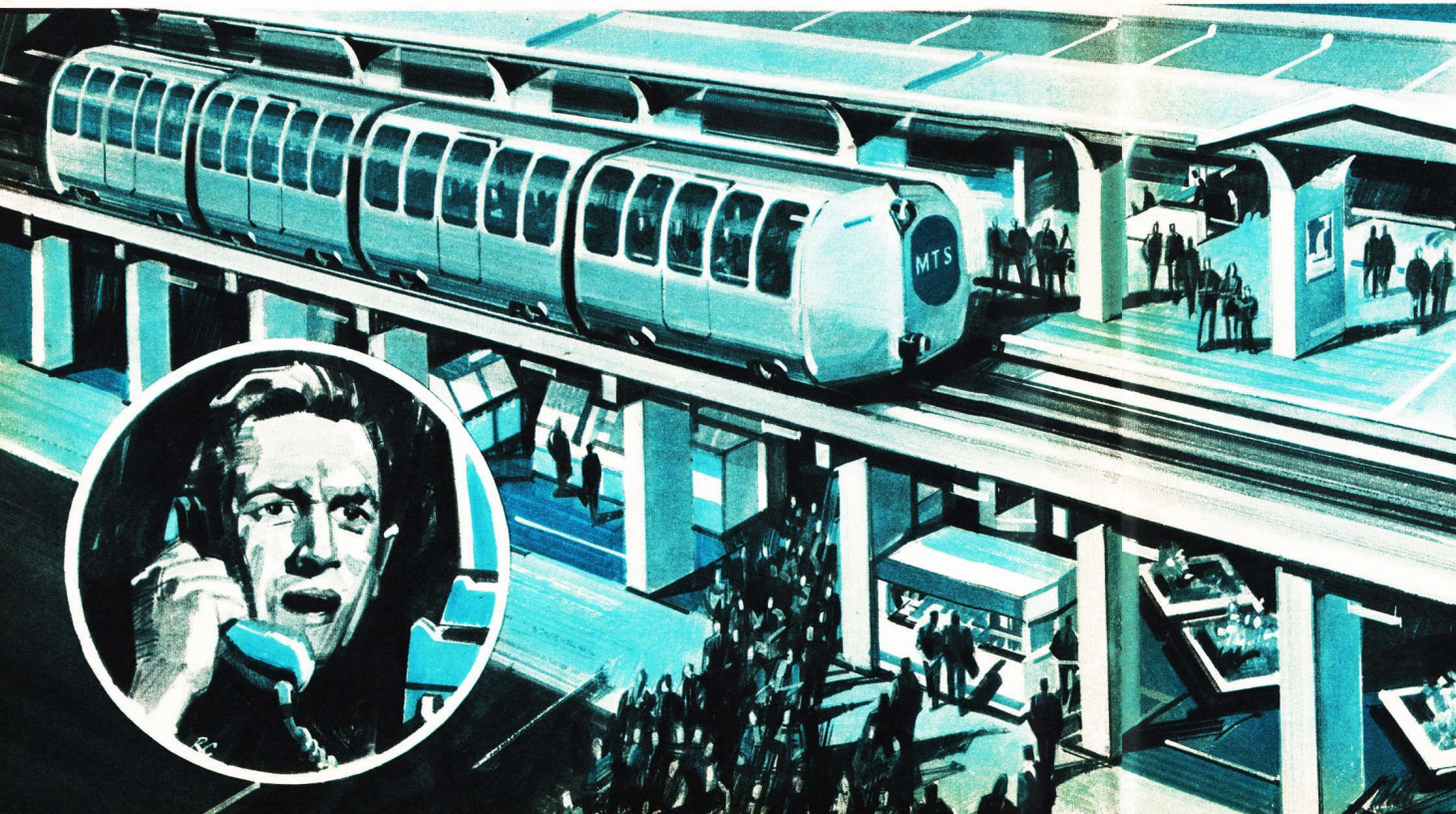
Printed reports on the trains and track are produced every 15 seconds by an electric typewriter which gets its information from the computers. As an added safeguard, every coach has a radio-telephone which passengers can use to report anything unusual to the central control staff.

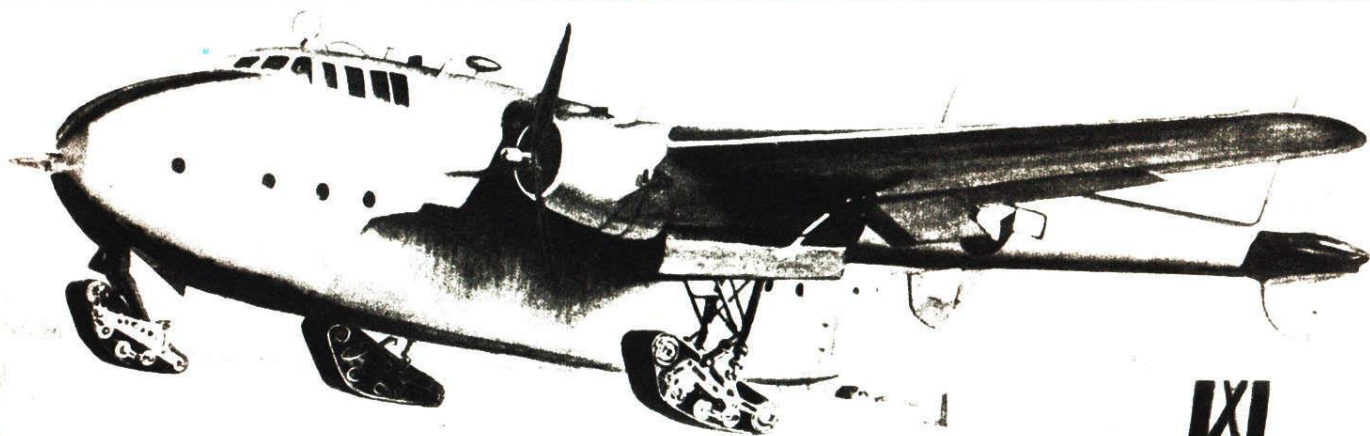
Models for several designs of coaches have been tried out, together with proposed layouts for stations.

Automatic Tickets

Passengers will buy tickets from automatic machines. At the end of the journey, the ticket is put into a machine which automatically opens a gate leading from the platform. Each ticket is coded with the correct fare for the journey. A device inside the machine "reads" the ticket and if the fare is incorrect the gate does not open. A somewhat similar system operates on some of London's Underground stations.

It is planned to have a network of 98 miles of Transit Expressway tracks operating by 1980. There will be 650 coaches in trains of up to twelve coaches, serving 80 stations. Each coach will be of stainless steel, 70 feet long and seating 80 passengers.





LANDING ON A CATERPILLAR CUSHION

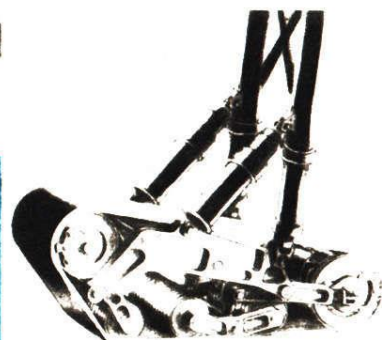
As freighter aircraft become bigger and bigger and able to carry increasingly heavy loads, the problem of landing them safely is becoming a serious one. Airports must have runways of thick reinforced concrete, which are very costly to build and maintain.

There is also another problem involved. An air freighter weighing 200 tons or more cannot make an emergency landing on a field or other soft ground. Its wheels would sink into the earth.

One attempt to solve the problem of safely landing heavy aircraft on soft ground is a caterpillar landing-gear. This is being developed by the Fairchild company of the USA.

Instead of having the conventional wheeled undercarriage, the experimental aircraft is fitted with three caterpillar tracks. One of the tracks replaces the nose-wheel and two others, one under each engine nacelle, replace the normal side landing-wheels.

Close-up view of one unit of the caterpillar landing-gear



Each of the tracks passes over two cylinders mounted on a frame. When the aircraft touches down, the tracks revolve freely over the cylinders. The tracks are four feet wide and made of heavy-duty rubber.

The width of the tracks and the forward movement of the aircraft prevent the tracks sinking into the ground. When the initial momentum of the aircraft is lost, the tracks engage with braking gear, and bring the aircraft to a slow halt. The whole operation is controlled by a lever in the cockpit.

During tests, a heavily-laden freighter fitted with the caterpillar fuselage was safely landed on a soft, sandy beach, on a rain-soaked field and on muddy ground. It has been calculated that by using the caterpillar undercarriage, the impact weight of an aircraft would be reduced by 75 per cent.

BURN THAT BORE-HOLE!

Boring holes through rock with the most efficient of electric or pneumatic drills takes about an hour for every foot of depth. This is not only slow, but it is expensive, as there is always the risk of accident to equipment.

Now, an American firm of mining engineers has invented a system called fusion-piercing.

A mixture of burning oxygen and a special fuel is blown through a nozzle against the rock to be drilled. The nozzle is made from an alloy of steel which can stand temperatures of up to 6,000 degrees Fahrenheit without melting.

The high-pressure flame leaves the tip of the nozzle at a temperature of 4,000 degrees Fahrenheit. This melts the rock. The pressure of the burning oxygen forces the melted rock under a high-pressure water hose. The water cools the melted rock and breaks it up into fine particles.

As it cools the rock, the water is turned into steam, which is at such a high pressure that it blows the rock particles out of the hole. The drill can bore through 17 feet of rock in an hour.

GREEN FOR DANGER?

Red has always been the recognised colour for danger and as a warning of hazards. But experiments carried out by the Medical Research Council suggest that in certain conditions green is more easily seen than red.

Tests showed that 80 in every 100 drivers thought that the red tail-lights of cars in front of them were much farther away than they actually were. This was because of a very common defect of the eyesight which opticians call stereopsis.

Another result of the tests was that to a great many drivers with good distant sight red lights appeared much more blurred than green or blue ones.

More alarming was the discovery that one in every 100 drivers tested did not know that he was suffering from a form of colour blindness called protanopsis. This is a vision defect which makes it difficult to pick out red from other colours.

Scientists who carried out the experiments believe that from the safety point of view a green tail light is much more logical than a red one.

WORLD of WONDER

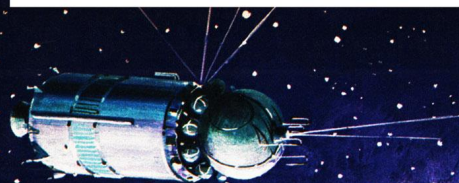
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**DANGER
UNDERGROUND**

The drama
of the Montespan
caves . . . See page 14



FAMOUS COUPLES

ANDRIAN AND VALENTINA

In March, 1962, there was some excitement in the cosmonaut training centre at Tyuratam in the USSR. The first women candidates were arriving. Among them was a pretty 25-year-old girl with deep blonde hair and a delicious smile. Her name was Valentina Tereshkova.

The two men who had the job of escorting her to a room were the next two to fly in space—Andrian Nikolayev and Pavel Popovich. It was Nikolayev, her future husband, a tough-looking man of 32 with thick brown hair, who carried her luggage.

Valentina, or Valya as she was called, remembered later “the sparkle of his dark velvety eyes”. But for the moment her feelings were in too much of a turmoil for any romantic thoughts to blossom among them. Here she was, on the brink of the greatest adventure of her life: what had seemed an impossible dream—to be the first woman cosmonaut—was coming true.

She must have felt honoured to have Nikolayev as a “porter”. She must have heard something of him, for, though he had not yet made his famous flight in *Vostok 3*, which was launched on 11th August, he was already talked about a great deal. He was the third Russian cosmonaut, the first being Yuri Gagarin (the first man in Space) in 1961, and the second P. Titov in the same year.

Nikolayev had been Titov’s understudy, and Titov called him “the calmest man in an emergency I have ever known”. He trained in the Red Air Force as a radio-operator, a gunner and then as a pilot.

On one occasion Nikolayev narrowly escaped death when flying a powerful jet fighter. He had to make a crash landing with the machine in flames. Miraculously he walked away from the blazing plane,

making exact notes of what had gone wrong.

He could put up with an astonishing amount of discomfort. Cosmonauts, of course, have to go through severe physical and mental tests—such as extremes of cold and heat, and long periods of lonely silence.

Nikolayev was able to endure confinement in the training device known as “the chamber of silence and horrors” nearly twice as long as anybody else, coming out quite cheerfully. While the sweat poured off him in the extreme heat (he was in there for 96 hours) he painted some fine pictures.

Dreams of Space

Nikolayev must have known something about Valya, because she had some fame as a parachutist. She had an important job in a cotton-mill and was head of the mill-workers’ parachute club. “Gagarin with a skirt” she was called, and her dreams took hold of her from the day when Gagarin said to Queen Elizabeth in London—“There’s no doubt a woman will fly in Space.”

Valya applied to Moscow for training, and soon she had joined that group of woman candidates flown to Tyuratam.

Nikolayev was followed into Space a day later by Popovich in *Vostok 4*. Their flights were something of a mystery to the rest of the world. They came very close to each other at one point—about four miles—and newspapers all over the world were wondering whether they were going to link up. But this was not the intention.

Television cameras inside the space-

craft showed them sleeping, and eating veal and chicken with plenty of appetite. They proved that Man was adaptable to long space-flights. The pictures were shown all over the world. In contrast to the quiet and dignified Nikolayev, Popovich was like a circus performer, making objects float and doing juggling acts with them. Compared with Titov, who had remained 25 hours in Space, Nikolayev spent about four days, making 64 orbits of the Earth; Popovich came down at the same time.

This flight made Nikolayev famous. He was pictured in newspapers all over Russia, frying eggs in his apartment, and was labelled “the most eligible Soviet



On the 16th June, 1963, Valentina Tereshkova, clad in a bright orange space-suit, waved goodbye to her colleagues and entered *Vostok 6* for her historic flight.

What better preparation for marriage than to share the tough but inspiring experience of a cosmonaut’s training?

bachelor”. He received hundreds of letters from Russian women.

But Andrian was already devoted to Valya and was now giving her advice on her training. She was passing all her tests, but she did find the solitary and soundless confinement test difficult. She longed, she said, “for the buzz of a fly or a mouse’s scuffling somewhere.”

Early in June, 1963, a selected group of men and women cosmonauts met the chairman of the State Commission. He said: “I name you, Valentina Tereshkova, to command the spaceship *Vostok 6*”.

Proud Moment

She stood up and everything about her suggested that she was very calm—her long soft hair in curls, her delicate features. But it was the most exciting moment of her life. Her voice remained calm, but her heart was pounding and her face flushed when she replied: “I am proud that I, a simple Soviet girl, have been given such trust.”

The next morning, when flying with other cosmonauts to Tyuratam, she said: “How beautiful it is!”

“Wait a bit,” said Nikolayev, sitting beside her. “You haven’t seen anything yet.” He was taking an interest in every detail of her life now, telling her to rest at every opportunity and not to lose her head.

Valya said afterwards: “I knew that this peace of mind was his second pair of wings, and I attempted to imitate him to some degree.”

They landed at Zvesgograd, the “City of Stars”, from which launches were made. In the evening there was a fishing party, presided over by Gagarin, to give Bykovsky a send-off—he was launched in *Vostok 5* the following day.

At the party, Nikolayev was senior fisherman and Valya peeled potatoes. In the cosmonauts’ cottage, where Valya was to sleep, an old woman said: “Take the bed that Gagarin used to have, Valyusha. You are also the first.”

On the morning of 15th June, Valya came out with a small red flag which her mother had specially made for her to take on the flight. She wore an orange space-suit with a white dove embroidered over the left breast. She kissed Gagarin, Titov, and Nikolayev, climbed into the *Vostok* and said: “I am Chaika” (Seagull). At 12.30 p.m., lift-off time, she was heard to say calmly, as if to herself: “I’m off.”

Valya and Andrian were married on the 3rd November, 1963. The wedding crowned a romance which had captured the imagination of the world.



But soon afterwards she was very excited. “I see the horizon. A blue, blue strip! That’s the Earth! How beautiful it is!” By that time Bykovsky was on his 31st orbit. Soon she was talking to the Russian Prime Minister Krushchev.

When she had done 48 orbits, she re-entered the atmosphere and landed by parachute in a field.

Valentina Tereshkova’s name was in all the world’s newspapers. Until her achievement, many scientists had been doubtful whether a woman’s body was adaptable to space-flight. Valya had proved that it was. Throughout the world people who were supporting women’s demand for equality with men—for the same rights and opportunities—were given tremendous encouragement.

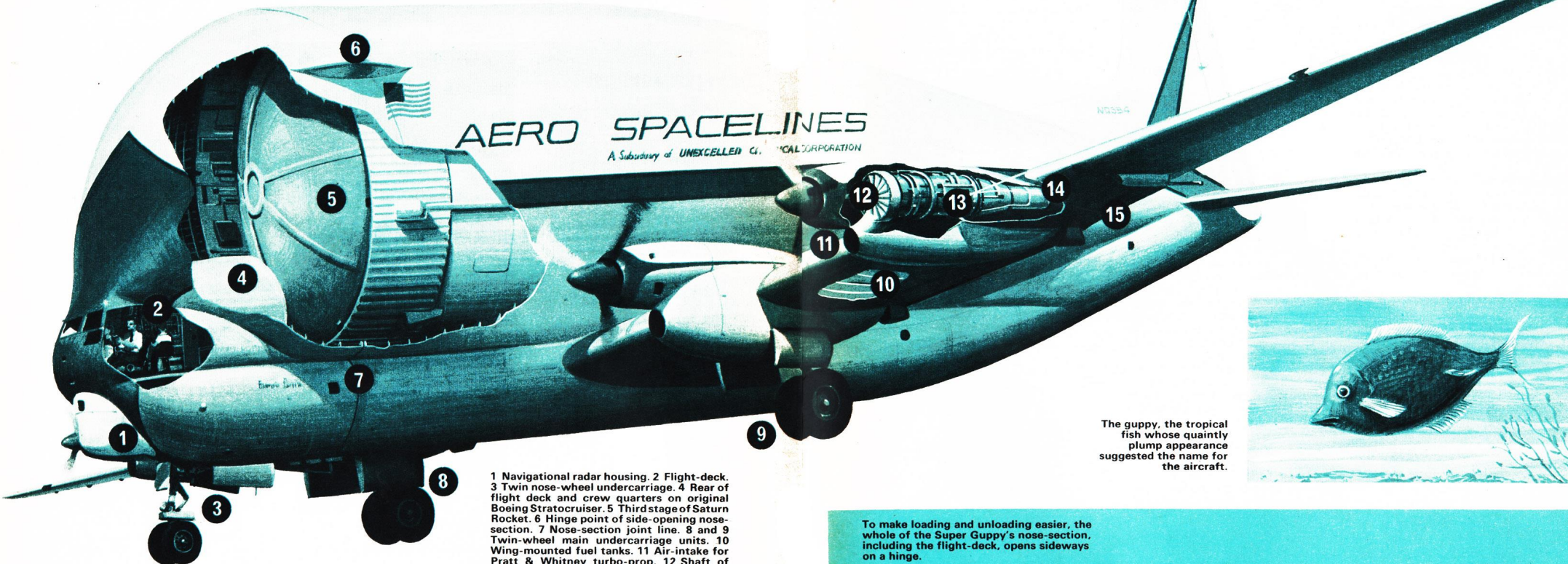
Nikolayev and Valya were married on 3rd November, 1963, and the following year they had a daughter.

In April of last year, Valya was appointed to the Central Committee of the Russian Communist Party. The pair have helped to welcome the visits of many American astronauts. All reports suggest that their marriage is as happy and successful as their achievements in Space.

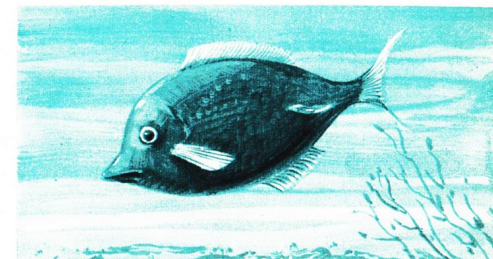
OUTSIZE AIRLIFT

To carry a fat load, you need a fat aircraft—hence the Guppies, those freight-planes that look like something out of a Disney film

MACHINES AT WORK



1 Navigational radar housing. 2 Flight-deck. 3 Twin nose-wheel undercarriage. 4 Rear of flight deck and crew quarters on original Boeing Stratocruiser. 5 Third stage of Saturn Rocket. 6 Hinge point of side-opening nose-section. 7 Nose-section joint line. 8 and 9 Twin-wheel main undercarriage units. 10 Wing-mounted fuel tanks. 11 Air-intake for Pratt & Whitney turbo-prop. 12 Shaft of turbo-prop driving the air-screw. 13 Pratt & Whitney T34 turbo-prop engine. 14 Jet exhausts. 15 Wing-flaps.



The guppy, the tropical fish whose quaintly plump appearance suggested the name for the aircraft.

In the past 20 years, aircraft-manufacturers have produced many impressive freight-planes, those "cargo-ships of the air"; and some of the most remarkable of all have been in the Boeing-Guppy series.

These are all based on the airframe of an airliner of pre-jet days, the Boeing Stratocruiser C97, but they are far from recognisable as members of the Stratocruiser family! The name of this series of freight aircraft is, of course, taken from that plump and rather ungainly-looking fish, the guppy.

Illustrated on this page is the Super Guppy. Powered by four Pratt and Whitney turbo-prop engines, giving it a cruising speed of 300 mph, it has a length of 141 feet and a wing-span of about 156 feet. It will carry a pay-load of about 23 tons.

The Guppy series of planes was launched some ten years ago especially to provide quick and safe transportation for booster-rockets and other large pieces of equipment for America's Space programme. Many of these are manufactured in parts of the USA far from the Florida launching sites,

and the alternative to air-lifting would be the much slower sea-transport, with its greater risk of damage.

Though questions of lifting capacity and strength were naturally important questions in the design of these unique planes, the biggest problems were those of providing enough space and convenient loading and unloading.

The Super Guppy, which entered service in 1965, was specially designed to accommodate such outsize items as the Saturn S-IVB third-stage rocket—much too large for the previous Guppies. The bulbous fuselage of the Super Guppy can take loads with a diameter of 25 feet.

To facilitate loading and unloading, the whole nose-section of the aircraft—which includes the flight-deck—swings open sideways on a hinge.



To make loading and unloading easier, the whole of the Super Guppy's nose-section, including the flight-deck, opens sideways on a hinge.

The Original Jekyll and Hyde. See page 18

WORLD of WONDER

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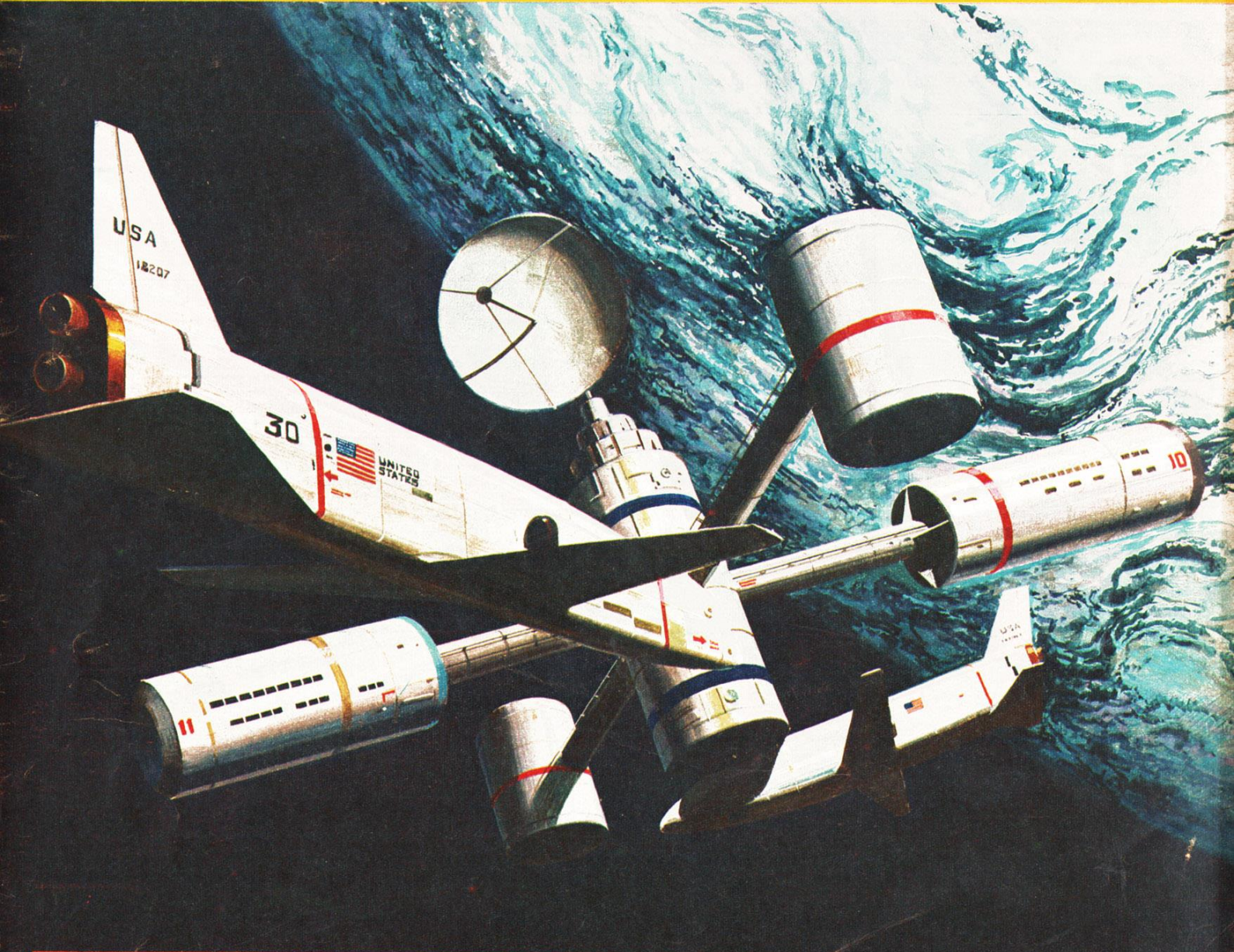
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Rhodesia 32c

Nigeria K.25

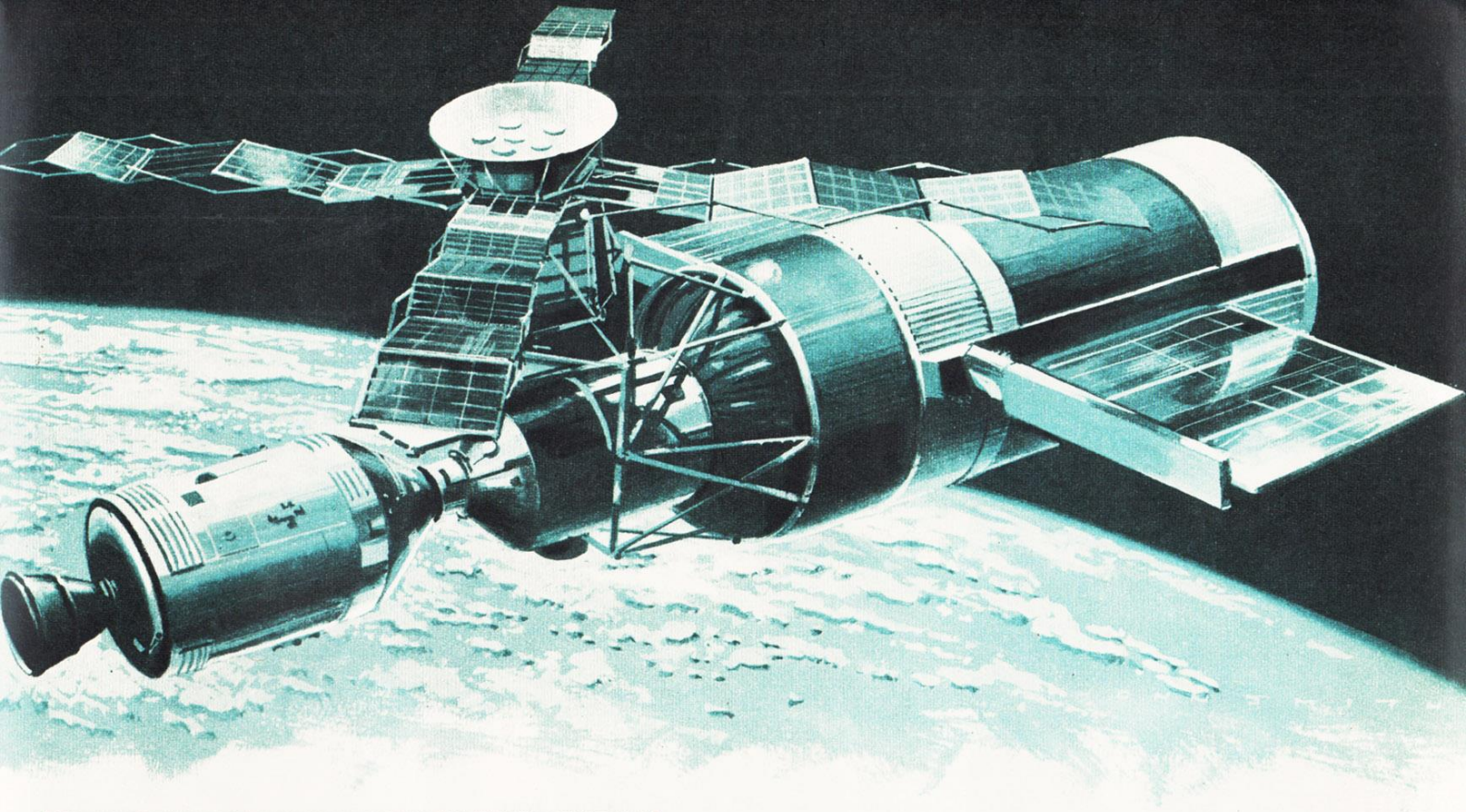
Malaysia 80c

Malta 11c.3



WORKSHOP IN SPACE

Science goes into orbit . . . See page 23



WONDERWORLD OF SCIENCE

LOOK OUT FOR SKYLAB!

The twelfth and last Saturn 5 will blast off from Cape Kennedy, Florida, on the 30th April of this year, leaving a trail of smoke and flame almost 400 feet long. It will not be going to the Moon or even have men aboard, for it will be carrying Space Station Skylab.

Over 100 feet long and 22 feet wide, Skylab will be placed in Earth orbit, awaiting the arrival of three crewmen—a commander, a scientist and a junior pilot.

It is America's first Space Station, and, in its 13,000 cubic feet volume, three three-man crews will conduct over 50 experiments in Space missions lasting as long as 56 days during 1973.

Skylab is designed to work out ways of gathering information on Earth's resources and also study air and water pollution problems, flooding, and the weather, the quality of soil and crops and the location of minerals.

Solar telescopes on board will increase our knowledge of the Sun and how it affects the Earth, while medical experiments will improve knowledge about Man—on Earth and in Space.

At the end of this month, Space Station Skylab is due to hurtle into orbit on the most ambitious Space-science enterprise yet attempted

Also, ways will be studied of putting the unique weightlessness of Space flight to industrial use on the ground.

On the 1st May, one day after blast-off, Flight-Commander Pete Conrad, the third man on the Moon, and making his fourth Spaceflight, will be launched into orbit aboard a modified Apollo command and service module. With him will be Flight-Scientist Dr Joe Kerwin and Pilot Paul Weitz. Conrad will rendezvous with Skylab, joining his docking probe with the docking collar on the Space Station.

The crew will work aboard Skylab for a month, and will then re-enter their Spaceship, undock and fly back to

Earth, splashing down in the command module after a normal Earth-orbital re-entry.

This crew and its enterprise will be known as "Skylab 2". Skylab 3 will follow in July, with Alan Bean, the fourth man on the Moon, as Flight Commander, and the mission will last up to 56 days. Yet another crew under Gerry Carr will go up in October for another 56 day mission, and this flight, Skylab 4, will complete the programme.

The Space Station will be left in orbit and will eventually fall back to Earth, to be destroyed during re-entry, though it is possible that the programme may be extended, in which case the Station would be sent into higher orbit.

Crews will begin work as soon as they have set up home in Space. In the multiple docking adaptor, to which Apollo attaches itself, and through which the astronauts travel to get into the main body of the Space Station, is the Earth Resources Experiment.

This consists of photographic and scanning devices which point Earthwards and will provide a marvellous opportunity to study the Earth, its

The lift-off from Cape Kennedy of the last Saturn V rocket, carrying Skylab, will have more power behind it than the total horsepower of all the cars in the United States.

Skylab—Man's hotel and laboratory in the heavens

problems, its riches, its needs. For instance, fishing can be improved by spotting possible rich areas, and navigation made safer by detecting icebergs and storms. Lakes and new sources of water can be examined, water pollution can be estimated, flood damage calculated.

Mineral wealth can also be studied from Skylab, so can volcanic eruptions, landslides and land changes. Town and country planning will be improved by landscape scanning from above.

The Skylab telescope is a remarkable piece of equipment. It has been converted from a redundant lunar module developed for Apollo, and is attached to the multiple docking adaptor and operated by astronaut-scientists in the adaptor.

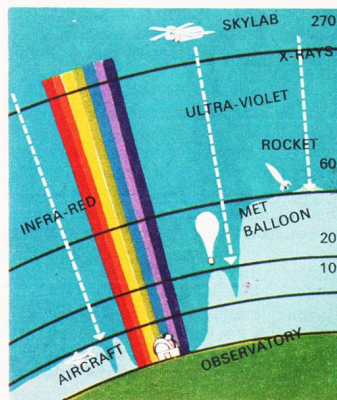
Studying the Sun

This telescope will be used to study the Sun. Eight major instruments are designed to provide information, which means that the crew and the scientists back on Earth will be able to see different aspects of the Sun at the same time.

Learning more about the Sun is important to us because it is the major source of the Earth's energy and life forms. Its behaviour affects everything about the Earth—the nature of the land,

The diagram on the right shows how scientists in Skylab can study the Sun and its radiations unhampered by the blanket of Earth's atmosphere. The light-blue outline shows the heights at which the Sun's different rays are filtered out by the atmosphere. Figures give heights in miles.

KEY: 1 Rocket engine nozzle. 2 Apollo service module. 3 Apollo command module. 4 Multiple docking adaptor. 5 Docking port. 6 Apollo telescope mount. 7 Airlock module. 8 Adapted Saturn V third stage. 9 Communications aerial. 10 Workshop. 11 Solar cell panels for generating power from sunlight. 12 Dining quarters. 13 Solar cell panels. 14 Metal mesh floor, assisting foothold in zero-gravity conditions. 15 Bathroom and waste-disposal compartment.



our atmosphere, climate and weather. A better understanding of the Sun could lead to new types of nuclear energy, perhaps to pollution-free production of electricity on Earth. And understanding the Sun could also lead to new knowledge of factors which influence our weather conditions.

Inside the body of the Spacecraft—the orbital workshop itself—the astronauts will do most of their work and will live. To get in, they will crawl through the adaptor, then through an

airlock module, which will also be an exit for "Space-walks".

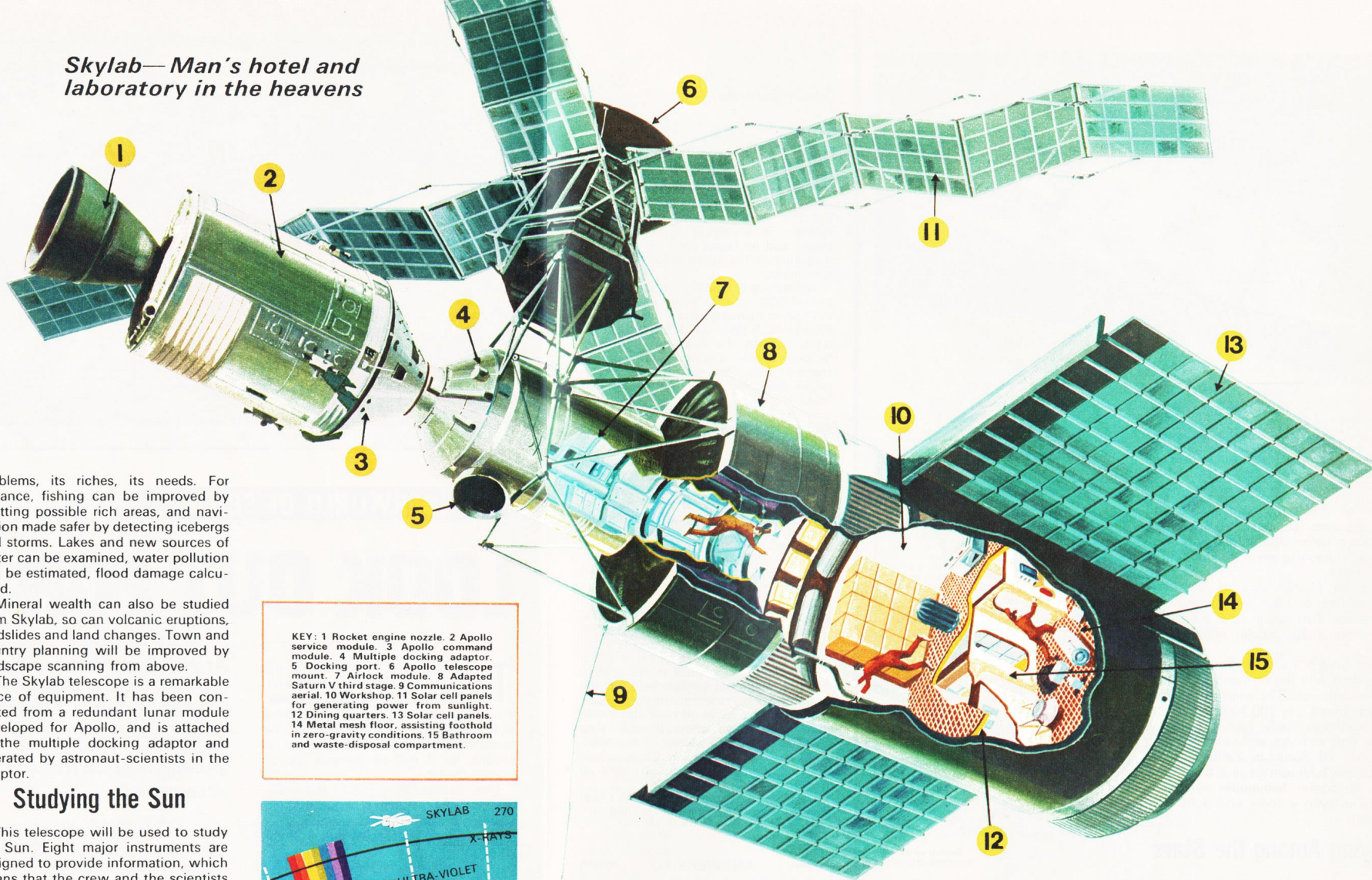
The workshop is split into two; on top, the work area, below, the living quarters, consisting of a living room, lavatory and bedrooms. Beneath is a giant empty liquid oxygen tank into which all the rubbish will be dumped.

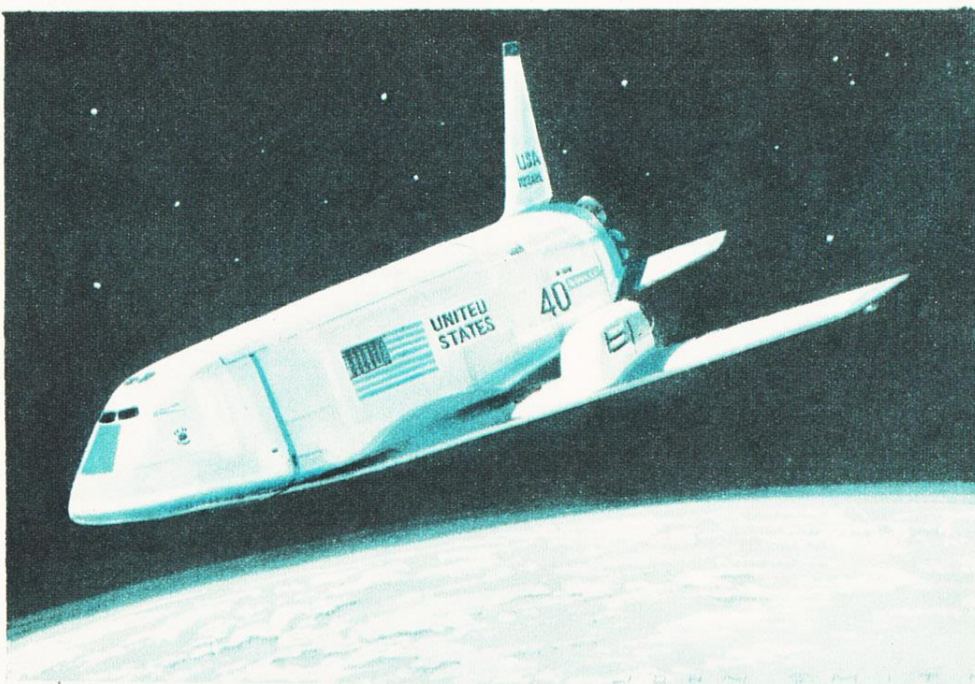
The astronauts will study the effect that Spaceflight is having on them and how weightlessness affects their hearts. Space crew fatigue problems due to disturbed sleep have been experienced

in the past, and this will be studied in an effort to cure it.

The crew will study all sorts of Space science and technological problems and conduct experiments, including the use of an airlock in the wall so that "outside" experiments can be tried out inside! The Milky Way will be studied by a camera fixed to this airlock.

Another vital experiment will be measuring the effect of movement by crewmen in a Spacecraft on the stability of the whole Space Station, and new





The next step after Skylab will be the employment of a "Space-shuttle" (pictured above)—a transporter that can be used and re-used.

ways of walking around the Station will be tried. Outside the Spacecraft various particles drift around and these will be studied to see if they affect the telescopes.

Special photographs of stars and galaxies will be taken, and, with no air to hinder their vision, the astronauts will have a spectacular view of the stars.

The crew's life will be luxury itself compared with the cramped conditions in a lunar module. The living room, called a "wardroom", is 100 feet square and has a kitchen, table, larder, oven, TV, radio, tape recorder, and a large viewing porthole 18 inches in diameter. There is a private bedroom for each of the crew and horizontal hammocks for them. There is even a toilet and a flushing system!

Flying Among the Stars

If a Moon-bound Apollo craft got into trouble it was on its own and its crew had no hope of rescue. Apollo 13, for instance, was lucky to get back. Should something go wrong with Skylab, a special rescue mission will be launched from Cape Kennedy. A rescue Saturn IB/ Apollo command and service module will be standing by with five seats.

Finally, many readers will be able to see Skylab as it flies across the sky against a backdrop of stars. It should be a very bright, star-like object moving swiftly through the blackness. Watch for Skylab!

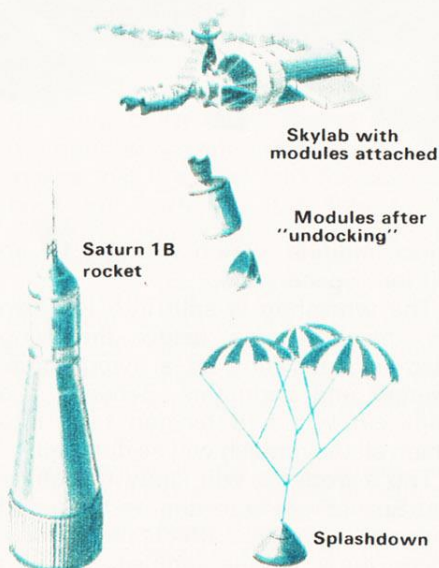
MISSION SKYLAB

1st Phase



Saturn V rocket

2nd Phase



Continued from page 11

Opening the first innings in a Test requires nerves of steel, for the fortunes of the match can so easily be settled in the first few overs if the opening partnership is broken quickly. Hobbs and Sutcliffe soon became the bowlers' despair. They opened for England 38 times, and no fewer than 15 times put a century on the board before the stand was broken.

In 1925 at Melbourne, Australia hit a record 600 runs in their first innings. A London newspaper ran the headline: AUSTRALIA 600—COME ON HOBBS. Jack rose to the occasion and with Sutcliffe made a spectacular opening stand of 283. The next day the newspaper headline said simply: THANK YOU, HOBBS.

"Master" and Sportsman

Little wonder that Hobbs was known to all cricketers as "the Master". Like all champions he played to win, but such was his rigid view of sportsmanship that he never took an unfair advantage. Indeed, on one occasion he gave himself "out" even though the umpire had not ruled against him.

It was in 1925 that Hobbs equalled and then passed W. G. Grace's long-standing record of 126 centuries. Hobbs played his last Test in 1930, against Australia, and his last match in 1934. For his "services to sport", he was made a knight by Queen Elizabeth II in 1953.

Sir Jack Hobbs died in December, 1963. A memorial service held for him in Southwark Cathedral attracted a vast crowd. And people all over the world recalled the days when he was "king of cricket". The President of the MCC (the Marylebone Cricket Club, which governs the sport in Britain) said of Hobbs:

"He was the greatest batsman I ever saw. He was also a great gentleman."

ANSWERS TO

WHAT DO YOU KNOW?

1. The Stockton and Darlington Railway; George Stephenson.
2. In 1966, when England defeated West Germany.
3. Emily Brontë; Currer, Ellis and Acton Bell.
4. To lay eggs.
5. North Atlantic Treaty Organisation.
6. Larch, the only one of the four that is not an evergreen.
7. Slander is spoken, libel is written or printed.
8. The boneshaker.
9. Sindbad the Sailor.
10. A herd.

SOLUTION TO PUZZLE IT OUT

6, 9, 15, 17, 53.

JUPITER
390 million miles
from Earth



Part 2

SATURN
790 million miles
from Earth

URANUS
1,680 million
miles from Earth

PLUTO
3,573 million
miles from Earth

SUN AND PLANETS COMPARED

If we imagine the Sun as a medicine ball two feet in diameter, Earth would be about the size of a pea, and its average distance from the Sun 430 feet. On this scale, a table of sizes for all the planets, and their distance from the Sun, might be drawn up as follows:

PLANET	SIZE	DISTANCE FROM SUN
Mercury	Grape-seed	164 feet
Venus	Pea	284 feet
Earth	Pea	430 feet
Mars	Pin-head	654 feet
Jupiter	Cricket Ball	$\frac{1}{2}$ mile
Saturn	Tennis Ball	$\frac{4}{5}$ mile
Uranus	Golf ball	1 $\frac{1}{2}$ miles
Neptune	Table-tennis ball	2 $\frac{1}{2}$ miles
Pluto	Orange pip	3 miles

MARS
34 million miles
from Earth

EARTH
93 million miles
from the Sun

VENUS
26 million miles
from Earth

MERCURY
57 million miles
from Earth

WHEELING ROUND THE SUN

As we saw last week, the stars in the sky appear to stay in fixed positions, to the extent that permanent charts of the sky may be drawn. Ancient astronomers were quick to notice this, and from the apparent solidity of the sky came to the conclusion that the Universe was a hollow sphere, with the Earth at the centre. The stars were fixed lights attached to the inside of the sphere.

This was a nice handy theory, and one which was easily understood by the scholars of the time. However, there was one rather inconvenient thing about it . . . and that was that certain of the stars had the irritating habit of moving around. What made this even more annoying was the fact that these "wanderers" happened to be the brightest and most easily visible of all stars.

The Greeks called these the *planetai*, "wandering stars", and it is from this that we have the word "planet".

The recognition of the planets for what they actually were was largely instrumental in changing Man's ideas about the nature of the Universe, and in a later article we shall take a closer look at the development from that hollow sphere to the awe-inspiring modern science of cosmology. For the moment, however, let us look at the planets which revolve about our Sun as simple objects in the sky.

New Planets?

Not including Earth itself, there are eight planets so far identified within the Solar System—there are possibly others awaiting discovery (see *WORLD OF WONDER* No. 143). All the known ones are visible from Earth. Some are bright, clear objects even when viewed with the naked eye; others can be seen only through a telescope.

So how do we tell the difference between a star and a planet?

The most obvious difference to a casual observer is that the light from a planet is steady. Though the light emitted by stars is thousands of times brighter, it has to travel to us over incomparably greater distances. By the

Closest to Earth, yet full of interest and mystery, are the other planets of the Sun

time starlight has crossed the light-years to us, and filtered its way through our murky atmosphere, it appears to "twinkle".

The light we see from planets is the same as that from the Moon: in other words, it is sunlight reflected off the surface. Although the planets are many millions of miles away from us, on the massive scale of the Universe this is equivalent to being "just around the corner". Consequently, we see planets as very bright and steady . . . distinctive in the sky for this alone.

Slow Movement

The other difference is that they move. If you go into your garden on a clear night, and locate one of the planets, you may question whether they move at all. Even if you looked a few nights later, it is doubtful whether you would be able to discern any movement in relation to the stars.

But over a period of weeks and months, it becomes quite evident that the planets do move.

Look at your wristwatch. Neither the hour-hand nor the minute-hand appears to move. But look again in a few minutes, and although the hour-hand looks as if it has hardly moved, it will be immediately clear that the minute-hand has. Such—on a scale immensely larger—is the gradual shifting of the bodies of the Universe.

Because of this very movement, it is impossible to fix the planets' positions on a chart, as we can with the stars. However, they are easy to find, because they always appear in one "strip" of the sky: the *Zodiac*.

The planets orbit the Sun and with

one or two minor exceptions are all in what is known as the *plane of the ecliptic*. If you imagine a gramophone-record, and say that the hole in the centre is the Sun, then the orbital paths of the planets would lie flat—or very nearly flat—on the surface of the record.

For this reason, the planets appear in the sky in roughly the same strip as described by the Sun during daylight hours. This varies from winter to summer: in winter the planets are "lower" in the sky, in summer they are "higher". This broad strip of sky is called the *Zodiac*.

Easily Located

The two planets easiest to locate—though not necessarily the easiest to see—are the inferior planets, Mercury and Venus. (They are called "inferior" because they are between us and the Sun.) They are easiest to locate because they are always in the same part of the sky as the Sun. Both are visible either shortly after sunset or shortly before sunrise, according to the time of year.

But because of their nearness to the Sun, they are invisible by day. Only when they are near the horizon, and thus viewed through the densest part of the atmosphere, do they come into view. In addition, we never see them as round globes: like the Moon when it is waxing or waning, we see them as crescents. Nevertheless, at certain times of the year Venus can be seen as a brilliant point of light. In fact, it is sometimes so bright that it will cast shadows.

The other planets—the "superior" planets—are always seen as globes. Mars appears as a pale but unwavering point of light . . . often with a faint reddish colour.

Jupiter is a splendid sight. It glows brightly and strongly with a steady white light. If you have really good eyesight, you may even be able to pick out two or three of Jupiter's moons. You will see them as tiny points of light beside the main body. If you cannot see them with the naked eye, even fairly

small binoculars will reveal them to you.

Saturn, the remarkable ringed planet, appears almost as bright. It is impossible to see the ring-formation with the naked eye, and binoculars will not help. The rings are clearly visible at most times of the year, but you will need a strong and well-mounted telescope for this.

Unfortunately, the remaining three planets (Uranus, Neptune and Pluto) do not lend themselves to ready observation. They are all a very long way from the Sun, and in addition are coloured rather darkly. To see them at night, even using a good telescope, you would need to know exactly where to look.

There are other bodies in the Solar System, and these are the *asteroids*. These lie in a broad belt between Mars and Jupiter, and by far the majority of them are too small and too dim to be seen. However, the largest of them—Ceres—is sometimes visible to the naked eye, but again you would need to know exactly where to look.

If you are interested in spotting the planets, some newspapers publish a chart of the sky once a month, indicating the areas where the planets and most interesting stars can be found.

Man-made "Stars"

In our modern times, we have a new class of "wandering stars" that the ancient astronomers did not have to contend with. These are, of course, the artificial satellites launched by America and the USSR . . . and many of these are easily visible to the naked eye.

It is, of course, absolutely impossible to keep track of these with a chart, but several newspapers list the times of appearance of all the brightest. The best time to see satellites is about one hour after sunset. By this time the sky will be completely dark, but the satellites will not be eclipsed by the Earth's shadow.

So these are the "wanderers" that inhabit the *Zodiac*. But this strip of sky has another meaning . . . one which some people claim controls the destiny of the entire world. We will be looking at this in next week's issue.

NEPTUNE
2,700 million
miles from Earth



A segment of the Sun, with the nine planets drawn to the same scale.

IN A TRANCE

Continued from page 21

nosis subjects both obeyed orders to throw acid at an experimenter and made to pick up a poisonous snake they'd been told was dangerous. (Both snake and experimenter were behind protecting glass). These experiments again proved that, in our present state of knowledge, hypnosis can be hard to handle and do much to explain the scientific hypnotists' objection to stage shows involving it.

They point out that practically anybody can be hypnotised, though some are better material than others. There is in fact a scientifically worked out scale of hypnosis, dividing the state into 30 different stages. This starts with relaxation and fluttering eyelids and goes right down to deep hypnosis, in which long-held fears and worries can be dispelled. Not everyone could be hypnotised to the last stage, but almost anyone could be taken through the first few stages. But the number of people who will carry out commands after they are brought out of the state of trance is far fewer—something like 60 per cent at most.

Many Uses

The most important uses of hypnosis today are to lessen tension in patients due for surgery, especially those who do not respond to, or are allergic to, chemical tranquilisers. In this field hypnosis is favoured by some dentists who prefer a co-operative patient to a frightened, or unconscious one. After surgery, too, hypnosis can be used to improve the patient's condition.

Surgery apart, hypnosis is also used successfully in effectively curing such conditions as insomnia, headaches, indigestion, stammering, eczema and some sorts of asthma.

Outside medicine new uses for hypnosis are found almost daily. Knowledge and skills can be improved under hypnosis and singers and actors improve their performance—so perhaps Trilby and her Svengali are not so wildly improbable. Football teams and athletes have been known to improve their performance. People have even been known to prepare for exams under hypnosis; though whether all this could be called "fair play" or sporting is another matter! Almost certainly the medical practitioners of hypnosis would regard it as ill-advised, if not downright dangerous, in our present limited state of knowledge.

However, with reawakening interest and fresh applications in the medical field it seems certain that before the end of the century we will have found out much more about the mysteries of hypnosis.

In 1821 the explorer Hamilton Hume reported seeing a strange creature in Lake Bathurst. His story was backed up by a squatter who lived near the lake.



DO YOU BELIEVE IN BUNYIPS?

For Australians, like the rest of us, tales of mysterious monsters provide a touch of romance in a work-a-day world

Six days before the Christmas of 1821, members of the Philosophical Society of Australasia, meeting in Sydney, were told that explorer Hamilton Hume had discovered a bunyip.

Not that Hume, 24-year-old Australian-born son of a prison official, called it a bunyip. The word was not known at that time. But a bunyip it was, none the less.

Three years before, penetrating into unknown country 115 miles south-west of Sydney, Hume reached Lake Bathurst, a shallow stretch of water nearly six square miles in area. This lake, he now disclosed, was the home of an animal that looked like a manatee (the tropical sea cow), or a hippopotamus.

A squatter living beside the lake backed up Hume's story. The animal had a head like a bulldog, he said, and made a noise like a porpoise. The local Aborigines called it "devil-devil" and said it stole their children.

Understandably intrigued, the Philosophical Society offered to pay Hume if he would obtain the skin or bones of the creature. But nothing ever turned up.

That is the way it has been ever since. With the passing of more than 150 years, literally hundreds of bunyips have been

reported from every part of Australia, without a scrap of solid proof of their existence.

There was a skull—Murrumbidgee Aborigines claimed it had belonged to a bunyip they killed in 1847—but it disappeared long ago. Everyone lost interest after the experts said it was either the skull of a colt or of a deformed calf.

Invariably bunyips are associated with swamps, rivers or lakes. Therefore most of the stories come from the border country of Victoria and New South Wales. Bunyip itself is a word from the language of the Corangamite Lake tribe meaning either devil, angel or god.

The bunyip is most commonly described as a large, furry animal, with a round, dog-like head and "hardly any ears". This led some people to fancy they must be seals that had found their way inland up rivers. But the River Murray

STRANGE STORIES

Aborigines did not go along with this theory. Seals, they said, were "the bunyip's brothers".

Not all bunyips fit the general pattern. The moolgewanke of Lake Alexandrina, for example, was "half-man, half-fish, with hair like a wig of reeds". The tunatabah or kine pratie was "as big as a bullock, with an emu's head and neck, a horse's mane and tail and a seal's flippers".

An animal reported from the Eumerralla River, near Port Fairy, Victoria, in 1848, had a head like a kangaroo, a long neck with a hairy mane and a mouth like a cavern. Natives credited this bunyip with being able to snare its victims by magic.

Yet even these weird creatures might have a rational explanation. Police at Wee Waa, New South Wales, announced in 1950 that the swamp creature that had scared people for six weeks was a bittern, a bird that makes a hollow, booming cry as it seeks food at night.

The bunyip spotted in Sydney's Centennial Park in 1960 had "a head like a kitten, a neck like a tortoise and a tail like a porcupine's quills". It turned out to be a musk duck, a somewhat exotic waterfowl with a peculiar fleshy lobe hanging from its bill.



The tunatabah monster was said to be "as big as a bullock".

Below: the "bunyip" reported in Sydney's Centennial Park turned out to be a musk duck!



Some naturalists believe the bunyip is an ancestral memory among the Aborigines of the diprotodon, a prehistoric wombat as big as a rhinoceros that formerly inhabited Australian swamps.

But most Australians don't care about explanations. They feel about the bunyip much as the British do about the Loch Ness Monster. To reduce it to cold fact would further deprive a world already running short of mystery and romance.

Not that the bunyip shows any sign of being explained away. Up to 1932, there had been continuous reports of the creatures in Tasmania's Lake Tiberias for 80 years. The bunyip of Comonderry Swamp, near Nowra, New South Wales, reported at intervals since 1912, made news again in March, 1972.

With Three Heads!

In July, 1972, fishermen told of seeing a monster near the mouth of Gudgerama Creek, 200 miles east of Darwin, in the Arnhem Land Aborigine reserve. It was 60 feet long, they said, with shiny scales and no fewer than three heads!

Two months later Australians read with delight that a team of British scientists was expected to investigate a bunyip reported in a lake near Lismore, New South Wales.

For those finding it hard to sight a bunyip, a coin-operated plastic version is available at Murray Bridge, South Australia. For the equivalent of 10p, it will rise from its watery lair, gnash its fearsome teeth, roar and paw the air.

Takings for the first week after it was installed as a tourist attraction in February, 1972, totalled more than £120!

Last year fishermen told of spotting a 60-foot monster at the mouth of a creek east of Darwin.



Agricultural engineers who are looking towards the future have been drawing up designs for the types of farm machinery which will be used in the 21st century. One of their ideas is for a revolutionary farm tractor.

The tractor will be about 30 feet long and mounted on heavy-duty pneumatic tyres. The tyres will not be of rubber but will be made from a special plastic material which is already available and is much stronger than the rubber now in use. The treads of the tyres will have a new form of grip which will enable the vehicle to drive over rough ground without damaging the soil.

Instead of being driven by a petrol or diesel engine, the tractor will be powered by a battery of fuel cells. These are much lighter than ordinary batteries and hold their charge longer.

The driver's cabin will be air-conditioned and electrically heated so that it will be comfortable in cold climates and in the tropics. The cabin will be mounted on a long arm so that the driver can swing it round to check that the plough or other implement being towed is operating correctly.

There will be a two-way radio telephone so that the driver can keep in touch with the farm headquarters.

INSTANT TIMBER? Giving trees a shock

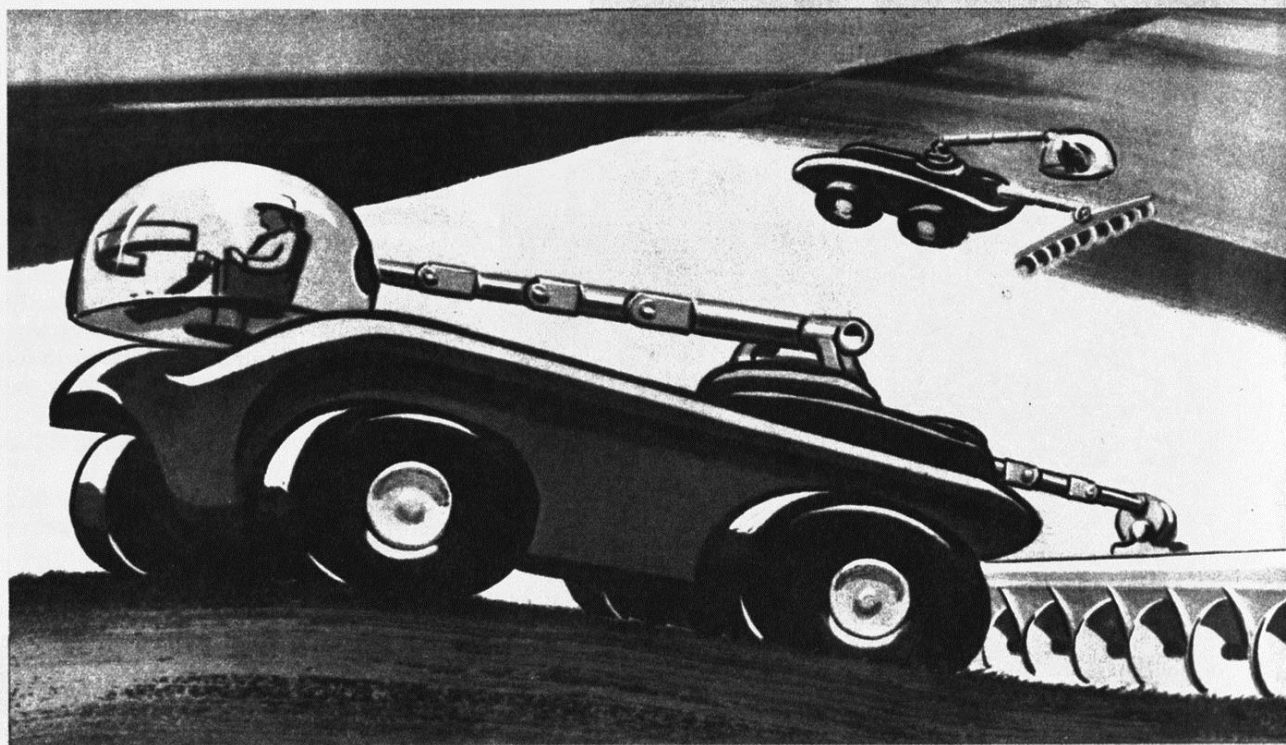
Wood is one of the most important raw materials used by Man. But it has one great disadvantage: trees take a long time to grow into timber suitable for cutting. If it were possible to speed up the growth of timber trees, timber for industry would be cheaper and more plentiful. That is exactly what an English forestry expert is trying to do.

Tree growth depends upon the rate at which the nutrients or tree "food" reach those parts of the tree where growth takes place. Most of the molecules of nutrients have been found to carry small electrical charges. This suggested that the movement of the nutrient molecules might be speeded up by applying to the tree's roots a weak electric current.

When this was done it was established that giving a tree an electric shock did stimulate growth. The technique is still in the experimental stage, and because of the normally slow growth of a tree it will be at least three years before it can be decided if the electrical treatment stimulates growth sufficiently for it to be worth while commercially.

TOMORROW'S FARM TRACTOR

The design for a tractor of the future includes an air-conditioned cabin mounted on an arm which can be swung round, enabling the driver to check the implement being towed.



FISTFUL OF ATOMIC POWER

WONDER WORLD OF SCIENCE

Nuclear power is not used as extensively as it might be owing to the vast cost of the reactors and generators needed to produce it. A nuclear power-station costs many millions of pounds to build and has to have huge buildings covering many acres of ground.

Not surprisingly, scientists are trying to solve the problem by designing "mini" atomic power-stations which will give industry and transport their own sources of nuclear energy. The first break-through in that direction was made in 1965, when the United States put into orbit round the Earth a satellite fitted with a nuclear power-station no bigger than a grapefruit.

Called a "Space-reporter", the purpose of the atom-powered satellite was to collect, and radio back to Earth, conditions existing hundreds of miles above the Earth. There had been previous Space-reporters, but they had to rely on solar batteries for the electric current needed to operate their radio transmitters.

Solar batteries use the heat of the Sun to generate an electric current. But to do this they need a lot of precious space and must have large reflecting surfaces to collect the Sun's rays. Moreover, they are easily damaged and there is always the risk of their breaking down.

Decaying Atoms That Produce Heat

On the other hand, the nuclear power-source designed for Earth satellites is very reliable and, most important of all, is very light: it weighs only four and a half pounds. It gives a continuous supply of electricity to operate recording instruments and a radio transmitter for five years.

Fuel for the mini power-station in Space consists of a small pellet of a radio-active element called plutonium. Like most radio-active elements, plutonium decays because its atoms are constantly changing. During the decaying process, the plutonium produces heat.

In the mini nuclear-power station, heat from the plutonium generates an electric current by means of a device called a

thermocouple. Invented in 1826 by a German scientist named Hans Seebeck, a thermocouple consists of two strips of metal, each of a different kind. When the metals are heated, as by plutonium decay, each heats at a different temperature. This difference of temperature produces an electric current between the two strips of metal.

The current obtained from the plutonium used on the first nuclear power-station in Space is very small: hardly enough to make a small electric light glow. But it is enough to keep the satellite active.

Above all, the satellite's mini power-station continues to operate for five years on one load of fuel. To get the same amount of current in the ordinary way would need 5,000 batteries of the type used on motor-cars. And the car-batteries would be worn out long before the end of five years.

Scientists were so impressed by the first mini power-station that they designed and built a bigger version. This weighs 30 pounds and produces 20 watts of current continuously for five years.

It keeps a satellite in Space for five years and could keep a train running for two years

Work is now progressing on a still bigger self-contained nuclear power-station. It will be able to provide all the energy needed to operate the instruments and equipment on a Space ship manned by a crew of five on a return voyage to Mars.

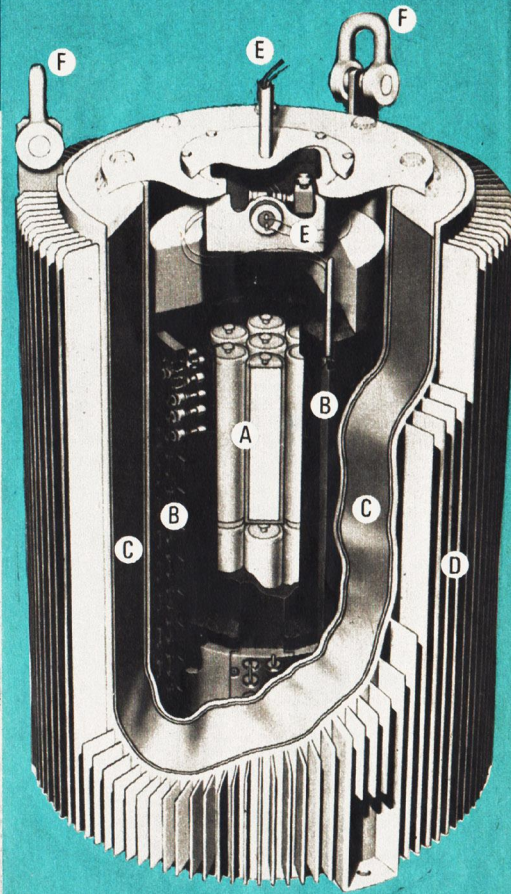
Plans are also on the drawing-board for a plutonium-fuelled power-unit for fitting into a railway locomotive. One load of plutonium fuel will be enough to keep the locomotive running for two years. Many nuclear scientists are convinced that eventually it will be possible to design and build nuclear power-units suitable for driving motor vehicles, or for supplying light and power for an ordinary house.

Valuable Fuel From Waste Material

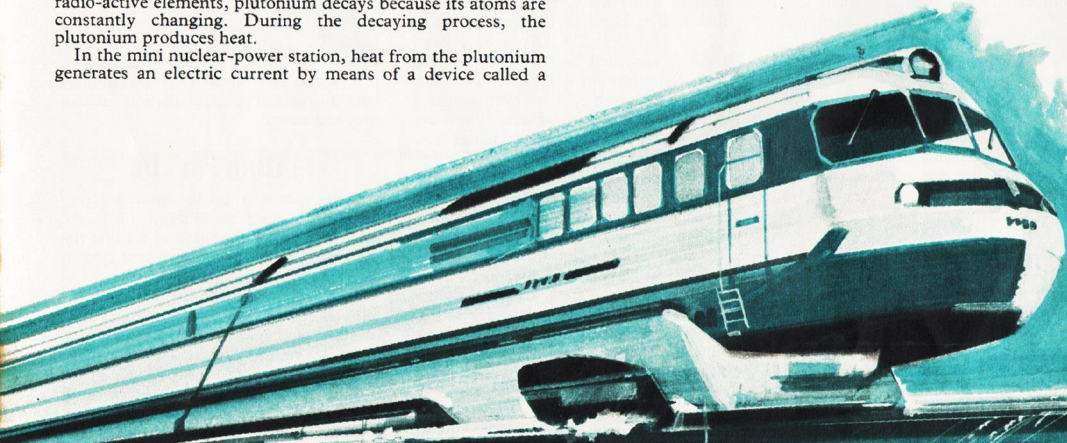
Successful development of small-scale nuclear power-sources would revolutionise the power needs of industry. Unlike conventional power-plants, nuclear generators have no moving parts, so that there would be very little wear and tear on the equipment. Also, plutonium is a comparatively cheap atomic fuel as it is extracted from the waste material left over by the big nuclear power-stations.

Mini nuclear power-stations that produce up to 400 watts of current continuously for ten years are already being tested. They have proved fully capable of supplying electricity in the Arctic and Antarctic regions and at sea. They appear to hold the answer to the problem of providing electricity where an ordinary power-station could not be built, or would be too expensive.

Small nuclear-power units using a different fuel, radio-active strontium-titanate, are at present proving their worth in remote weather-stations, and experimentally for navigation aids at sea, for aircraft navigation beacons and on off-shore oil-rigs.



A mini nuclear power station, fuelled with radio-active strontium-titanate and designed for land-based unmanned weather stations. A. Capsules containing strontium-titanate. B. Thermocouples generating current from heat released by decay of strontium-titanate. C. Anti-radiation shield. D. Outer case with cooling fins. E. Leads taking current from thermo-couples. F. Lifting shackles.



BALLOON'S EYE VIEW

Stratoscope I, suspended from its balloon, carries the telescope and other instruments aloft.

Now that men can land on the Moon and space probes are put into orbit round Mars and Venus, the idea of using balloons to study the stars and Space seems rather out of date. But the humble balloon is playing a vital part in astronomy.

Telescopes carried aloft by giant balloons provided the solution to a problem that had always limited observation by astronomers. Any object's image as seen through a telescope on the ground is distorted by the blanket of atmosphere which surrounds the Earth.

The problem was solved by the balloon. Several attempts have been made to take observations through small telescopes which astronomers took up in ordinary balloons. They all failed, because the balloons could not rise high enough, and they moved about too much for the telescopes to be sighted accurately.

Then, on the 25th September, 1957, the first practical balloon telescope rose from the Earth. Called *Stratoscope I*, it was designed by Dr Martin Schwarzschild, Professor of Astronomy at Princeton University, USA.

The balloon fabric was a very thin but exceptionally strong polyethylene. The main envelope was 300 feet long and 160 feet wide. This main balloon was lifted off the ground by a second or auxiliary balloon mounted on its top. As the auxiliary balloon rose, it pulled after it the main envelope which had been filled with helium gas.

Pioneer Ascent

As the main balloon gradually gained altitude, the gas expanded so that the envelope became an onion-shaped ball, 140 feet in diameter and holding 27 million cubic feet of expanded helium gas.

Suspended from the main balloon was a twelve-inch refracting telescope to which was attached a 35mm camera. The telescope assembly included various instruments for measuring and recording temperature, air pressure, dust and moisture content of the atmosphere and radiation. There was also an automatic radio transmitter and receiver which enabled a ground control-centre to keep a constant track of the balloon's position and height.

*Hoisted high
above the Earth,
a telescope
"sees" far more
than an
astronomer on
the ground*

Stratoscope I's pioneer ascent was devoted to observation of the Sun, the star nearest to Earth. To keep the telescope aimed directly at the Sun, there was a light-sensitive guiding device consisting of a glass prism shaped like the edge of a knife.

The prism split light coming from the Sun into two parts. This reflected half of the light from the Sun to one side of the prism and half to the other side. If the telescope moved off target, more light fell on one side of the prism. This caused an electronic relay to switch on a small electric motor which moved the telescope until it was back in the correct position.

The camera attached to the telescope carried an automatic mechanism for taking one picture a second.

Many Advantages

Other equipment included a radio command-system for bringing the balloon and its load back to Earth.

On its first ascent the balloon carried 14 tons of equipment and reached a height of nearly 20 miles. It remained aloft for seven hours, when it was brought back to Earth.

The balloon telescope has many advantages over the artificial Earth satellite. Astronomers do not see the actual photographs taken by the cameras attached to the satellite-borne telescopes. The photographs are converted into radio signals on the satellite and transmitted back to Earth, where they have to be translated back into pictures at a ground station. Also the telescope camera and other equipment on the satellite are eventually lost.

When a balloon telescope completes its mission, a radio-signal is transmitted from the ground. This operates a relay to open a valve on the balloon envelope, and release some of the helium.

Immediately the descending balloon reaches a certain distance from the ground, a second signal is transmitted. This operates a mechanism which separates the balloon envelope from the telescope and instrument assembly. Three parachutes open and lower the telescope, camera and other equipment gently to the ground.

Below: Radio links between balloons, satellites and ground stations make it possible to relay over long distances the information collected by the balloons' instruments. Right: Both balloons and satellites are of importance to astronomers. This unmanned satellite observatory has five telescopes (A), and is powered by solar panels (B).

As the balloon becomes completely deflated, it also comes to Earth, but at some distance from the instruments, so that they are not damaged by the mass of fabric falling on them.

After the instrument package has landed safely, a small transmitter on the package starts sending out a continuous signal to guide a recovery party to it.

Balloon telescopes have provided astronomers with photographs of objects which are far too small for detection through ground-based telescopes. One such observation revealed bright spots of gas emerging from the hot solar surface and has led to a better understanding of how the internal heat of the Sun is carried outwards. A balloon telescope's camera also provided the first clear picture of the centre of a sun spot.

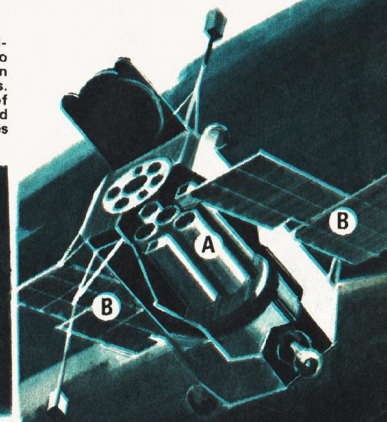
Other data collected by balloon telescopes have resulted in astronomers having to revise many of the opinions previously held about the life-cycle of stars, their composition, structure and internal processes. It was a balloon telescope which first proved that the atmosphere of Mars contained water vapour and that there is less ice in Space than there was once thought to be.

Blown Round Earth

One of the most ambitious research programmes carried out by balloons was completed last year, when 30 balloons were released at intervals from Ascension Island. The balloons were loaded with an electronic package to transmit temperature and other information existing at a height of 80,000 feet.

As the balloons were blown round the Earth with the winds, they transmitted their instrument readings to a Nimbus weather satellite in Polar orbit 500 miles above the Earth. The satellite relayed the information from the balloons to a ground station in Alaska. The balloons remained aloft for several months to provide a continuous picture of all that was happening in the upper atmosphere.

Above: the *Stratoscope II* after launching. The main balloon appears at this stage like a cable connecting the telescope to the launching balloon.





There'll be no more "roughing it" on your caravan holiday if you can get one of these

Luxury Homes On Wheels

When General Motors planned to build a new type of caravan, the market research department wrote to thousands of potential customers asking them what kind of caravan they would like most. The answers were fed into a computer, which worked out an average of the replies.

From the details thus obtained, the company's designers planned the caravan illustrated on this page. The caravan was put into production and proved to be a tremendous success.

Most people wanted a self-propelled caravan, so it was put on a steel chassis and powered by an engine driving on the front axle. To ensure that the vehicle rested on an even keel when standing on rough ground, the four rear wheels have a mechanism which automatically adjusts the wheels to bumpy ground.

To prevent the body from rusting, it was built up from panels of aluminium and glass fibre bonded together. So that the caravan would be cool in Summer and warm in Winter, the interior of the walls was sprayed with a plastic foam.

Many people had pointed out that the average caravan swayed badly when moving

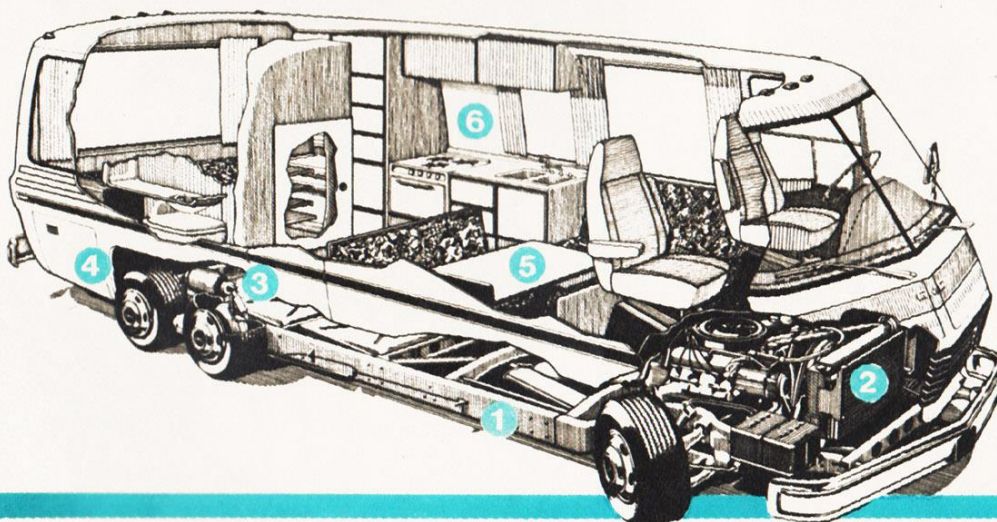
at high speed and when taking corners. This was overcome by having the bottom of the vehicle only 15 inches (38 centimetres) from the ground, so placing the centre of gravity only 37 inches (94 centimetres) above the ground.

The caravan has power-assisted steering and a six-wheel braking system, with disc brakes on the front wheels and pneumatic brakes to the rear wheels.

Bed and Bunks

The caravan is 26 feet (eight metres) long. There is a dining space that can be cleared to make way for a double bed, and a sofa that can be converted into two bunks. The kitchen space contains an electric refrigerator, an electric cooker, and a bathroom with a shower, providing electrically-heated water. The electric light and power come from a generator driven by a small petrol-engine.

People using caravans often complain that because of the confined space they are bruised by bumping into corners of the furniture. So every corner in the vehicle is rounded, there are no knobs on drawers and cupboards and all hinges are concealed.



CUT-AWAY VIEW OF THE COMPUTER-DESIGNED CARAVAN

KEY:

- 1 Steel chassis-frame.
- 2 Front-wheel drive.
- 3 Air-spring for rear wheels.
- 4 Mechanism adjusting rear wheels for parking on uneven ground.
- 5 Dining-table which can be lowered flush with floor.
- 6 Electric cooker, and sink with hot and cold water.

WORLD of WONDER

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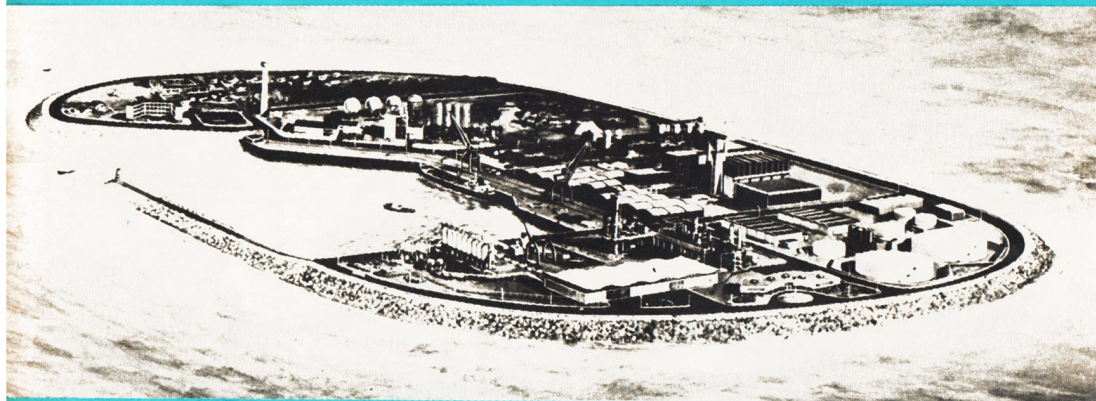


MAN-MADE ISLAND

Read all about this exciting new project on page 14

Overcrowding? Shortage of building space? Perhaps one answer in the future will lie in the . . .

MAN-MADE ISLANDS



Shortage of land for industrial development, overcrowded housing conditions, together with industrial pollution of the atmosphere and waterways, are becoming serious problems in many parts of the world. One region in which such problems are pressing is where the Netherlands and Belgium border the North Sea.

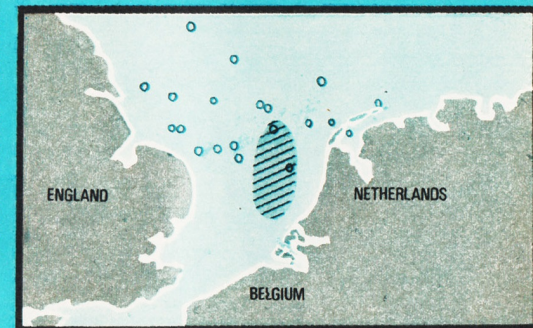
One of the most revolutionary proposals for a solution is to build artificial islands some miles off the coast. Large factories, power stations and oil refineries would then be established on the man-made islands. This would free land for agriculture and housing.

Stupendous Task

Appropriately, the idea of artificial islands has been suggested by Dutch engineers, who have a vast fund of experience in the winning of land from the sea. So convinced are they of the possibilities of the idea that they have already drawn up plans for the construction of an island in the North Sea to cover an area of 5,000 acres.

Supporters of the project are convinced that such a stupendous task is well

Above: how the artificial island would look from the air. Right: the southern North Sea region. The shaded area is considered especially suitable for building islands. The circles mark points where natural gas is being tapped.



within the capacity of today's technology and equipment.

Although the cost of building an artificial island of 5,000 acres would run to hundreds of millions of pounds, it would be no more than the Netherlands has already spent in reclaiming land from the sea and building dykes and other coastal defences.

There are in the North Sea a number of shoals and sandbanks which rise to within a few feet of the surface of the water. Most of these are within a few miles of the coast.

One of these would be selected as the centre or core. The 5,000-acre area of the proposed island would then be surrounded by a double row of steel or wood piling. The space between the two lines of piling would be filled with clay, stone, sand and quick-setting cement. This mixture would build up into a solid wall several feet above sea level.

When the wall was completed giant pumps would suck out the thousands of millions of gallons of water inside it. Next, millions of tons of clay and stone

ALL EYES ON THE SKIES

As this year draws towards its close, there is mounting excitement in the world of astronomy. It is all because of two objects millions of miles away from Earth. One of them is speeding away from us; the other is heading straight in our direction.

This winter the night sky is likely to be lit up by a brilliant curtain of light, golden and fan-shaped, which will also be visible by daylight. And this Winter, too, we may finally learn some of the secrets of the giant and mysterious planet Jupiter.

The object that is leaving Earth far behind is America's Space-probe *Pioneer 10*. If it succeeds in its mission, it will be one of the technological triumphs of the Age. The unmanned craft has been winging its way through Space for over a year-and-a-half, and still has not reached the planet that is its prime target. It is so far away that already it takes 45 minutes for radio signals to reach it.

Speeding To Jupiter

Pioneer 10 will reach the vicinity of Jupiter, after travelling 620 million miles (about 1,000 million kilometres) — at a speed that would take it across the Atlantic in two minutes!

It is expected to take measurements and carry out experiments, including TV photography, while passing about 100,000 miles (160,000 kilometres) above the planet's surface, and to return all the data it gathers to Earth.

When that is done, it is hoped that *Pioneer* will fly onwards to do the same for Saturn in 1974, and afterwards to continue on its way, to become the first Man-made object to break free from the Solar System.

Jupiter, that huge, colourful, almost dynamic planet, appears to have its own energy source, and it "broadcasts" radio signals of enormous power, as well as radiating three times as much heat energy as it receives from the Sun. Its size can be judged from the fact that in volume it is over a thousand times as large as Earth, and in mass it equals all the other known planets combined.

Jupiter, in fact, is almost to be reckoned as a star in its own right, although it is a satellite of the Sun.

Its dense and cloudy atmosphere may have the necessary ingredients to produce life—ammonia, methane, hy-

This should be a winter to remember, with the Pioneer Space-probe unveiling the mysteries of the giant planet Jupiter — and the first appearance of a new comet

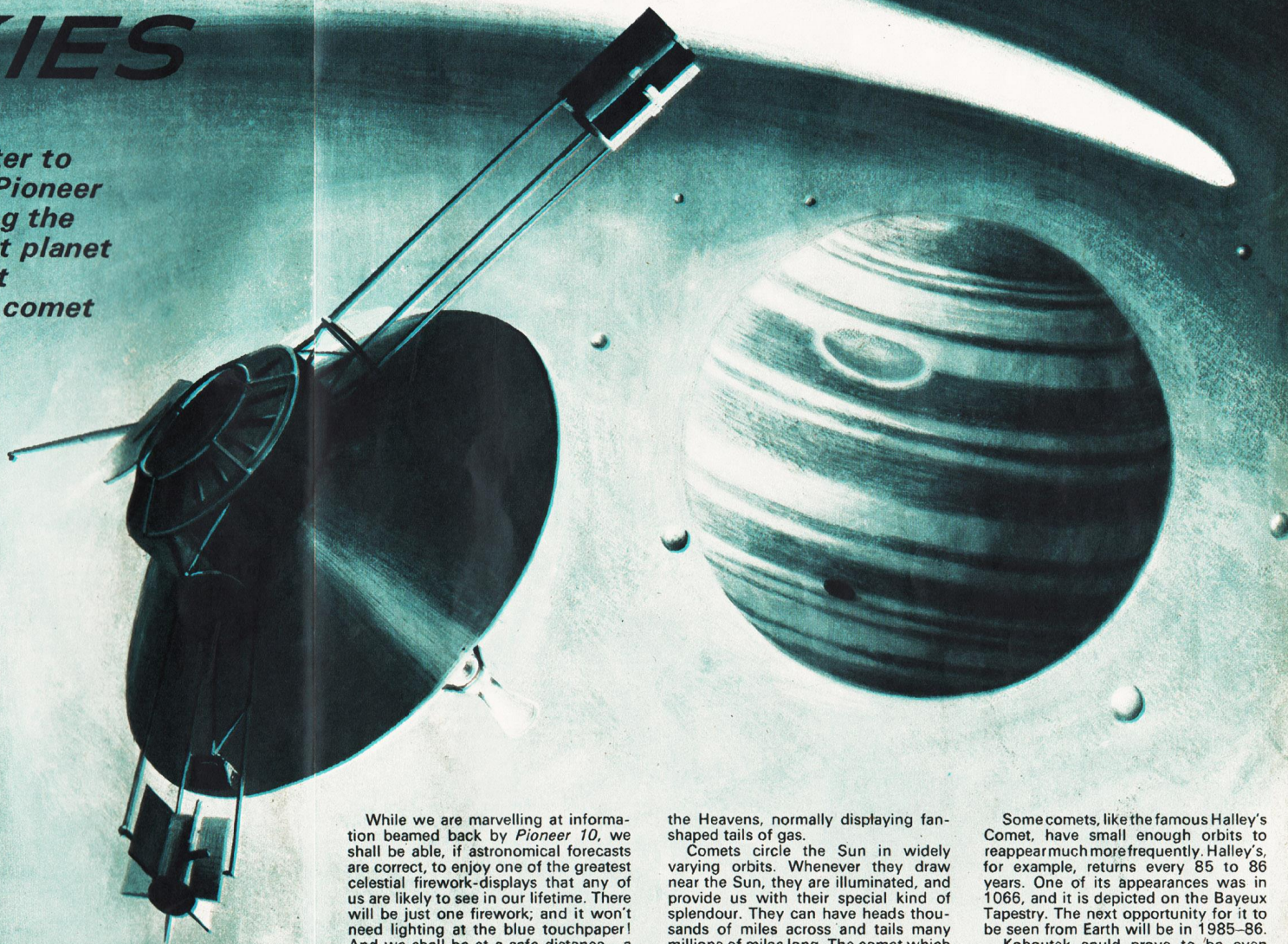
drogen and possibly water. These are the same ingredients believed to have produced life on Earth 4,000 million years ago. Scientists think that large regions below the frigid cloud layer may be at "room temperature".

Striped in glowing yellow-orange and blue-grey, it "floats" in Space like a brightly-coloured rubber ball. It has a huge red spot in its southern hemisphere. Called the "eye of Jupiter", this red, oval-shaped blob is 30,000 miles long and 8,000 miles wide (48,000 by 13,000 kilometres)—large enough to fill several Earths. The red spot could be an enormous standing column of gas, or even a raft of hydrogen ice floating on a bubble of warm hydrogen in the cooler hydrogen atmosphere, and bobbing up and down at 30-year intervals, disappearing and re-appearing.

The planet spins more than twice as fast as Earth. It has twelve "moons" of which two are about the size of Mars. There is probably no solid surface, but a thick gaseous atmosphere, within which there is an ocean of liquid hydrogen, and then a final layer of viscous matter cloaking a solid hydrogen core.

Celestial Fireworks

After lifting the veil from Jupiter's mysteries, *Pioneer 10* will travel on, and seven years later, billions of miles from Earth, it should still be working, using a nuclear power source. Solar cells would be useless to it, for the Sun would by that stage be just a bright star in the Space-probe's dark sky. A sister ship, *Pioneer 11*, is already on its way, and by late next year more secrets of Jupiter may be revealed.



While we are marvelling at information beamed back by *Pioneer 10*, we shall be able, if astronomical forecasts are correct, to enjoy one of the greatest celestial firework-displays that any of us are likely to see in our lifetime. There will be just one firework; and it won't need lighting at the blue touchpaper! And we shall be at a safe distance—a matter of about 93 million miles.

The "firework" is a comet.

What is a comet? To the Ancient Greeks the tail of a comet resembled a woman's flowing tresses; so they called it *kometes*, meaning "long-haired". That's how the name originated. Comets are actually combined masses of dust, water vapour, ice and gases which trail

the Heavens, normally displaying fan-shaped tails of gas.

Comets circle the Sun in widely varying orbits. Whenever they draw near the Sun, they are illuminated, and provide us with their special kind of splendour. They can have heads thousands of miles across and tails many millions of miles long. The comet which we will be watching is Kohoutek; it may prove to have a tail 30 million miles (nearly 50 million kilometres) in length.

There are no historical records of anyone having seen this comet before. This means that it must have an incredibly distant "aphelion"—the point at which its orbit takes it farthest from the Sun.

Some comets, like the famous Halley's Comet, have small enough orbits to reappear much more frequently. Halley's, for example, returns every 85 to 86 years. One of its appearances was in 1066, and it is depicted on the Bayeux Tapestry. The next opportunity for it to be seen from Earth will be in 1985-86.

Kohoutek could prove to be even more spectacular than Halley's Comet.

Just to add yet more astronomical excitement to our Winter, towards its end a grand finale is in store for us: TV pictures from the surface of Mars—if the USSR's two probes *Mars 4* and *5*, achieve their objects.

Winter may be cold; but things will be hotting up out there in Space!

The Young Magazine With Something For Everyone

WORLD of WONDER

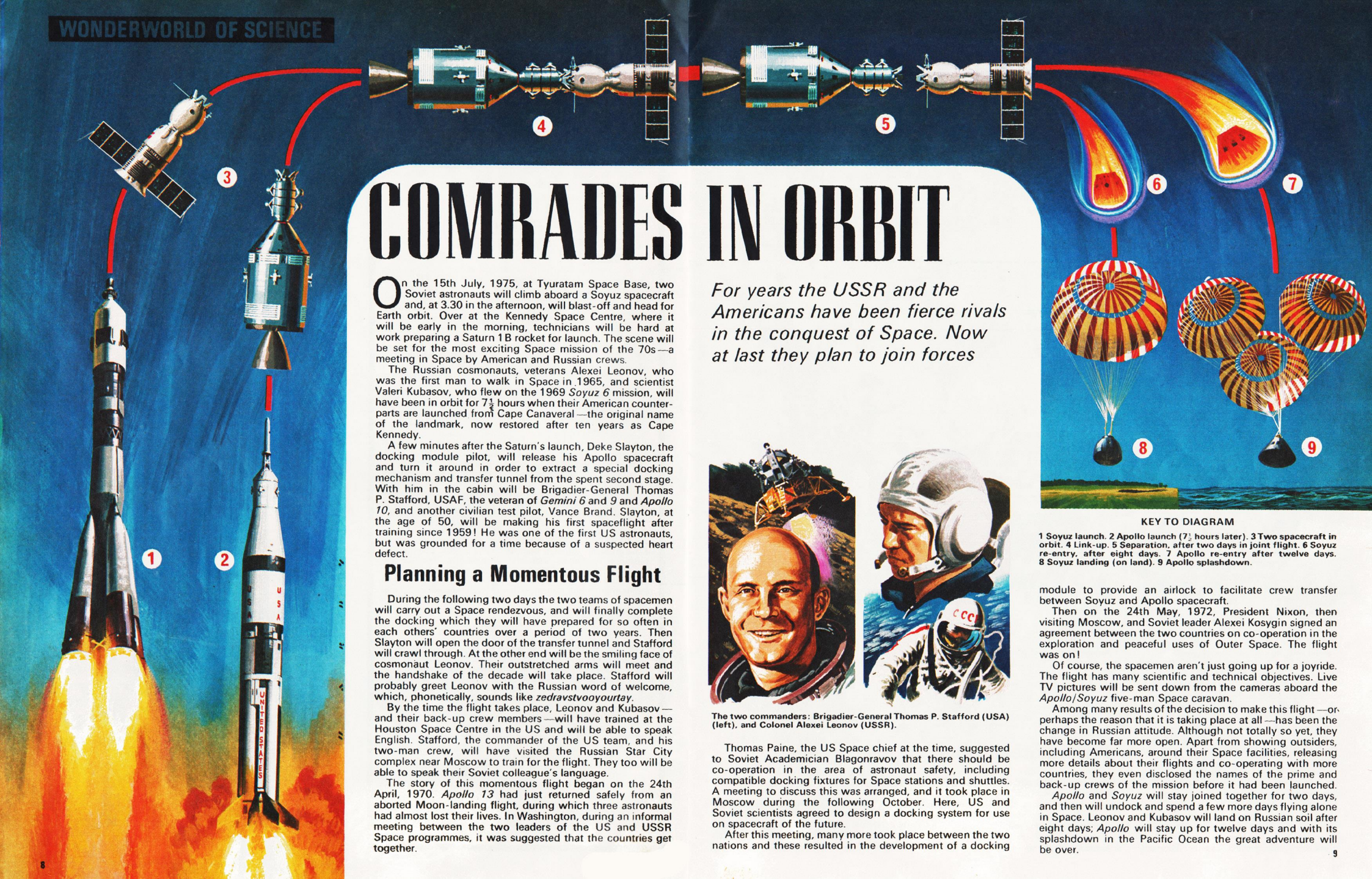
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COMRADES IN SPACE

Read about this great
project on page 8



COMRADES IN ORBIT

For years the USSR and the Americans have been fierce rivals in the conquest of Space. Now at last they plan to join forces

On the 15th July, 1975, at Tyuratam Space Base, two Soviet astronauts will climb aboard a Soyuz spacecraft and, at 3.30 in the afternoon, will blast-off and head for Earth orbit. Over at the Kennedy Space Centre, where it will be early in the morning, technicians will be hard at work preparing a Saturn 1B rocket for launch. The scene will be set for the most exciting Space mission of the 70s—a meeting in Space by American and Russian crews.

The Russian cosmonauts, veterans Alexei Leonov, who was the first man to walk in Space in 1965, and scientist Valeri Kubasov, who flew on the 1969 *Soyuz 6* mission, will have been in orbit for 7½ hours when their American counterparts are launched from Cape Canaveral—the original name of the landmark, now restored after ten years as Cape Kennedy.

A few minutes after the Saturn's launch, Deke Slayton, the docking module pilot, will release his Apollo spacecraft and turn it around in order to extract a special docking mechanism and transfer tunnel from the spent second stage. With him in the cabin will be Brigadier-General Thomas P. Stafford, USAF, the veteran of *Gemini 6* and 9 and *Apollo 10*, and another civilian test pilot, Vance Brand. Slayton, at the age of 50, will be making his first spaceflight after training since 1959! He was one of the first US astronauts, but was grounded for a time because of a suspected heart defect.

Planning a Momentous Flight

During the following two days the two teams of spacemen will carry out a Space rendezvous, and will finally complete the docking which they will have prepared for so often in each others' countries over a period of two years. Then Slayton will open the door of the transfer tunnel and Stafford will crawl through. At the other end will be the smiling face of cosmonaut Leonov. Their outstretched arms will meet and the handshake of the decade will take place. Stafford will probably greet Leonov with the Russian word of welcome, which, phonetically, sounds like *zedravstvoooyourtay*.

By the time the flight takes place, Leonov and Kubasov—and their back-up crew members—will have trained at the Houston Space Centre in the US and will be able to speak English. Stafford, the commander of the US team, and his two-man crew, will have visited the Russian Star City complex near Moscow to train for the flight. They too will be able to speak their Soviet colleague's language.

The story of this momentous flight began on the 24th April, 1970. *Apollo 13* had just returned safely from an aborted Moon-landing flight, during which three astronauts had almost lost their lives. In Washington, during an informal meeting between the two leaders of the US and USSR Space programmes, it was suggested that the countries get together.



The two commanders: Brigadier-General Thomas P. Stafford (USA) (left), and Colonel Alexei Leonov (USSR).

Thomas Paine, the US Space chief at the time, suggested to Soviet Academician Blagonravov that there should be co-operation in the area of astronaut safety, including compatible docking fixtures for Space stations and shuttles. A meeting to discuss this was arranged, and it took place in Moscow during the following October. Here, US and Soviet scientists agreed to design a docking system for use on spacecraft of the future.

After this meeting, many more took place between the two nations and these resulted in the development of a docking

KEY TO DIAGRAM
1 Soyuz launch. 2 Apollo launch (7½ hours later). 3 Two spacecraft in orbit. 4 Link-up. 5 Separation, after two days in joint flight. 6 Soyuz re-entry, after eight days. 7 Apollo re-entry after twelve days. 8 Soyuz landing (on land). 9 Apollo splashdown.

module to provide an airlock to facilitate crew transfer between Soyuz and Apollo spacecraft.

Then on the 24th May, 1972, President Nixon, then visiting Moscow, and Soviet leader Alexei Kosygin signed an agreement between the two countries on co-operation in the exploration and peaceful uses of Outer Space. The flight was on!

Of course, the spacemen aren't just going up for a joyride. The flight has many scientific and technical objectives. Live TV pictures will be sent down from the cameras aboard the *Apollo/Soyuz* five-man Space caravan.

Among many results of the decision to make this flight—or perhaps the reason that it is taking place at all—has been the change in Russian attitude. Although not totally so yet, they have become far more open. Apart from showing outsiders, including Americans, around their Space facilities, releasing more details about their flights and co-operating with more countries, they even disclosed the names of the prime and back-up crews of the mission before it had been launched.

Apollo and *Soyuz* will stay joined together for two days, and then will undock and spend a few more days flying alone in Space. Leonov and Kubasov will land on Russian soil after eight days; *Apollo* will stay up for twelve days and with its splashdown in the Pacific Ocean the great adventure will be over.

PACKING THEM IN

"Freight container" travel for airline passengers

With the ever-increasing size of airliners like the Jumbo Jets, the delay in embarking and disembarking large numbers of passengers is becoming a serious problem at international airports.

At a recent conference of passenger-traffic managers, one delegate foresaw the day when passengers would be pre-packed in containers which would be loaded into the aircraft.

The idea is not so very far in the future. The German engineering firm of Krupp has already designed a scheme for the container handling of passengers. Indeed, Krupp have gone as far as building a working scale-model of the scheme. This is how the full-scale system would work.

After passengers due for a flight have completed passport, ticket and luggage formalities in the usual way, they take their seats in a room which is laid out with the seats arranged in the manner of the interior of an airliner. The whole "waiting-room" is mounted on castors.

Shortly before the time scheduled for take-off, the room, with the passengers seated inside, is sealed off and temporary lighting and air-conditioning units are switched on. Then the whole compartment is slid out of the terminal building and on to a huge fork-lift truck. The truck carries the container to the waiting aircraft. There the container is slid into the aircraft through an opening in the nose of the fuselage.

Up to four containers can be accommodated on two decks in the airliner. Once the containers have been securely anchored to rails in the aircraft, the aircraft's power, internal communication and pressurising systems are connected up to them.

The windows of the containers are so arranged that they line up with the windows of the aircraft. This gives passengers the advantage of double-glazing. Luggage compartments below each container do away with the necessity of having to separate passengers from their luggage. This saves delay in collection at destinations.

When an airliner with its load of passenger containers arrives at its destination, it taxis up to the reception terminal with its nose open. The containers are then unloaded by fork-lift truck. The passengers file out of the containers straight into the transport which takes them from the airport.

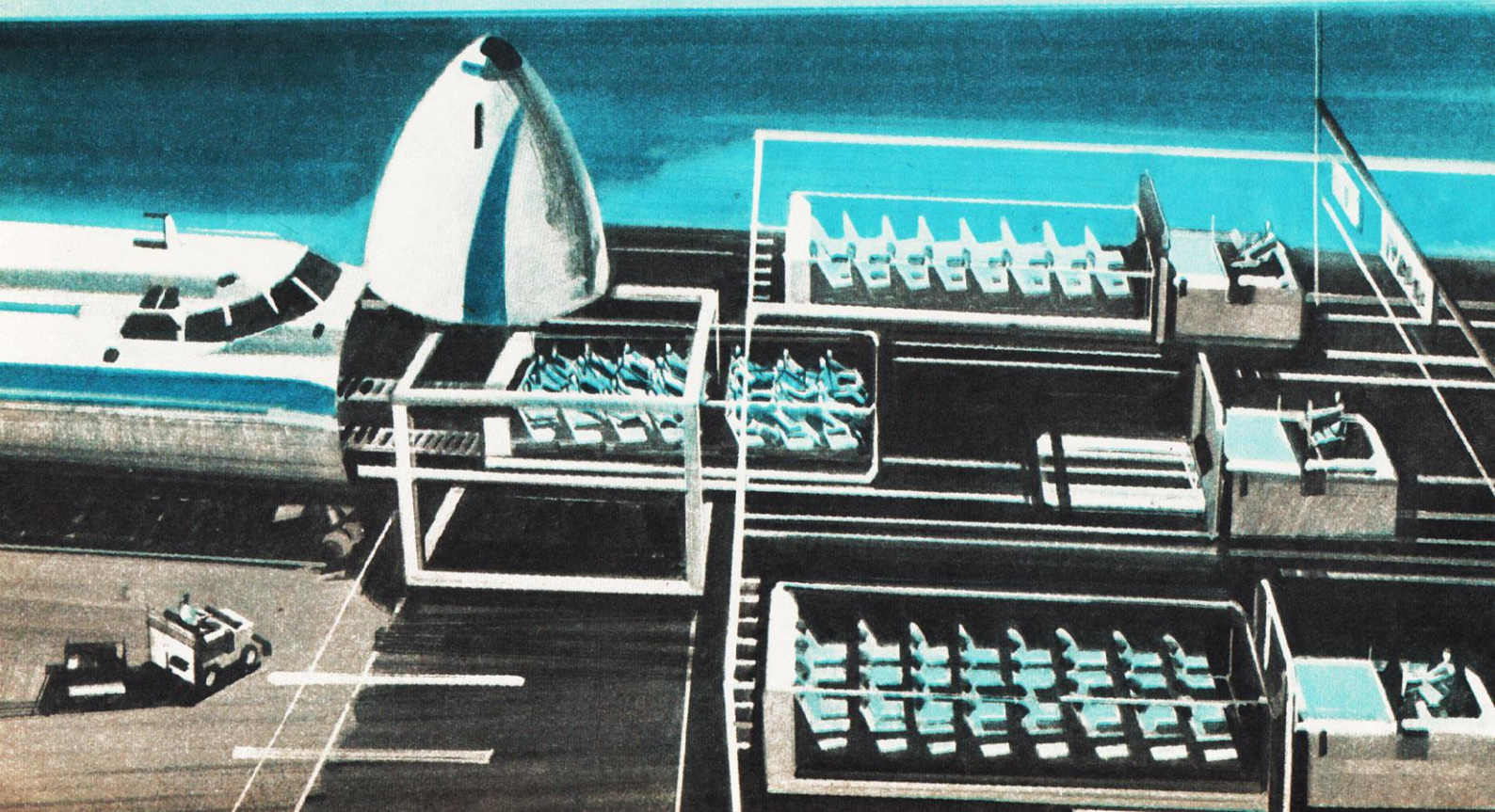
Cutting the Turn-Round In Half

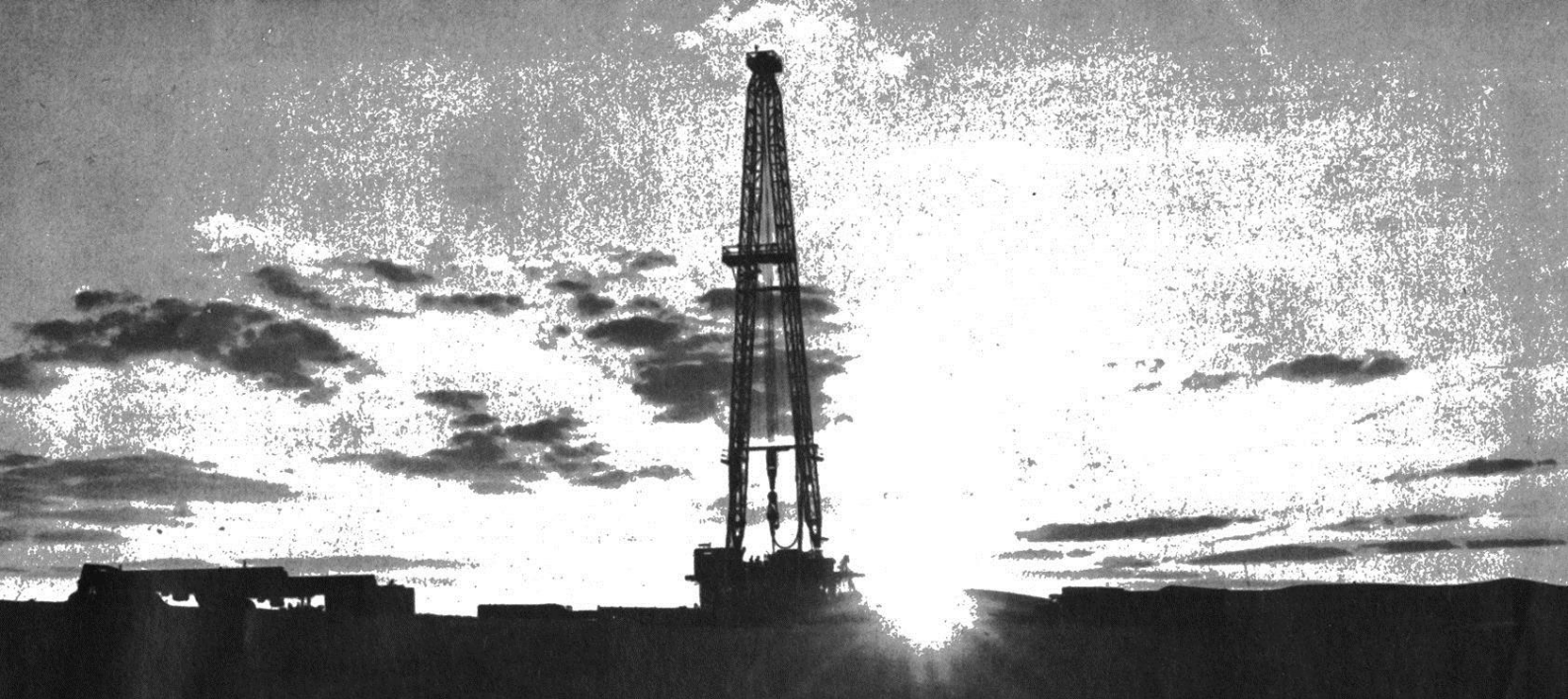
Tests with a computer have shown that a Jumbo Jet could load or unload a full passenger list in about 15 minutes. By using special equipment for refuelling, inspecting and re-provisioning, the turn-round time between flights of a Jumbo Jet can be reduced by 50 per cent.

Krupps have been so impressed by model and computer tests of passenger containers that they have suggested carrying the scheme a stage farther.

Instead of passengers being taken by coach from city centres to the airport, they would enter the containers at the city centre. The containers would then be loaded on to the flat cars of an underground railway linking the city and the airport. Such a system could cut the total time of a journey by some two or three hours.

How a passenger container will be slid out of the embarkation bay into the fuselage of the airliner.





Where Does the Oil Come From?

With the threat of the world's oil supplies drying up hanging over our whole way of life, the search for it becomes desperately urgent. On the next three pages we make a tour of the world's chief oil-producing regions

Oil is the life's blood of most of the world's industry and transport. And those countries with oilfields and untapped oil reserves within their own borders are fortunate indeed.

Altogether more than 50 countries are engaged in oil production. The main producers are the Persian Gulf States of the Middle East, North America, South America, the USSR and Rumania, North Africa, and South-East Asia. In 1972 all the nations of the world produced 2,617 million tons of oil, but this was mostly gobbled up by the world consumption of 2,590 million tons.

Western Europe and Japan depend heavily on oil from the desert lands of the Middle East, where almost two-thirds of the world's proved oil reserves are located in the countries of the Persian Gulf. But on the figures for 1972, the United States is the world's largest producer of oil, with 532 million tons. The USSR is second with 393 million tons, Saudi Arabia is third with 287 million tons.

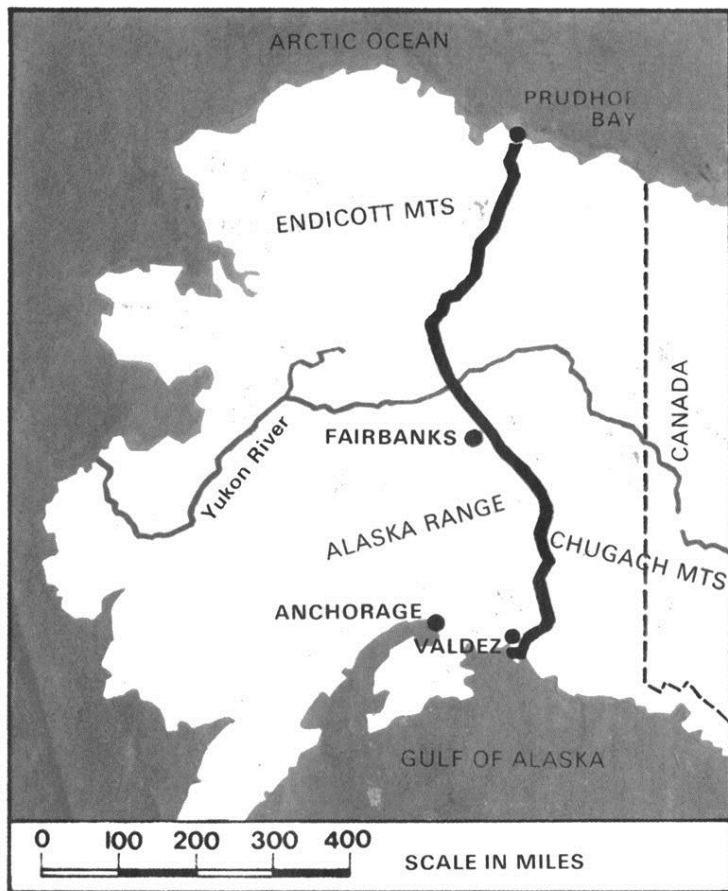
The United States is also the world's largest consumer of oil, using more than 600 million tons a year. So even the United States must import oil to keep its wheels turning.

The chief oil-producing States of America are Texas, California, Kansas, Wyoming, Oklahoma and Louisiana. But what may be the richest oilfields ever discovered in North America were struck on the north Arctic coast of Alaska in 1967.

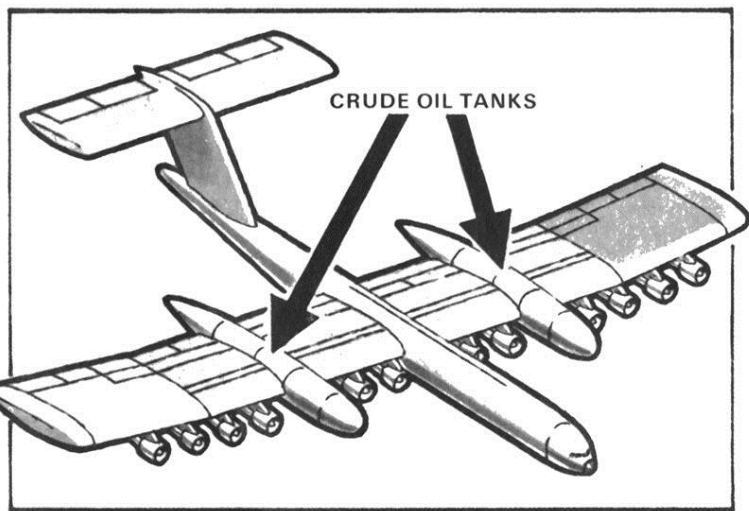
This spectacular find is expected to yield 500 million tons a year when full production is reached in 1980. Work is now

The everlasting search for oil—at sea as well as on land. Pictured here is British Petroleum's drilling platform *Sea Quest* off the north-east coast of Scotland.





In this map, the planned route of the Trans-Alaska pipeline is shown by the black line running from north to south. The oilfields on the north coast are expected to produce 500 million tons of oil a year by 1980.



Giant "flying tankers" may in future have a part to play in the oil trade. Our picture shows such an aircraft, a project of the American Boeing company. Powered by twelve engines, it would carry a load of over 1,000 tons.

going ahead to build the 800-mile Trans-Alaska pipeline to link the oilfields on the north coast to the Gulf of Alaska in the south. From there the oil can be shipped to the Pacific coast of the USA.

Other exciting oil discoveries of recent years have been made in the North Sea, where Britain, Norway, the Netherlands and several other West European nations have been drilling.

When full production is reached in 1980 (or even earlier) the North Sea fields could be supplying two-thirds of Britain's oil needs.

The Soviet Union has a number of rich oilfields in its vast land. Of these the Tyumen oil region in Western Siberia recently took the lead in production—two million barrels in 24 hours.

The Friendship Pipeline

The Soviet Union exports a large amount of oil to other Communist States and to Western Europe. The Druzhba, or "Friendship", pipeline carries some 25 million tons of oil a year from the USSR to neighbouring communist countries. Rumania is second only to the Soviet Union in European oil production.

As we have seen, it was in Iran, in 1908, that oil was first tapped in the Middle East. Today Iranian wells pump up five million barrels a day. At Abadan, Iran has one of the largest oil refineries in the world; and at Kharg Island the world's largest oil-loading jetty.

The desert kingdom of Saudi Arabia is a treasure house of "black gold". For under the hot sands lie one-fifth of the world's total proven oil reserves. Exploration for oil began here in 1934 and the first oil was found in 1935.

The North African republic of Libya is a newcomer to oil production. Oil was discovered there in 1959 and by 1970 Libya had become a major exporter. Other African nations rich in oil are Algeria and Nigeria. In the Far East, Indonesia is the leading producer.

Before its transportation to refineries throughout the world, the crude oil collected from the wells goes to a gathering centre where any dissolved gas or water which may be present are removed. It is then transferred by pipeline to the storage tanks at the shipment terminal.

Moving oil through pipelines over great distances has become possible through the use of high pressure pumps and the development of steel pipes that are safe, cheap, and reliable.

There are long-distance pipelines in the USA, the USSR, Canada, North Africa, the Middle East, and Europe. The Trans-Arabian pipeline—known as Tapline—is 1,000 miles long, running from Saudi Arabia on the Persian Gulf to the

In the oilfields of Siberia, transportation provides the same sort of problems as those faced in Alaska. Material for pipelines has often to be flown in by helicopter.





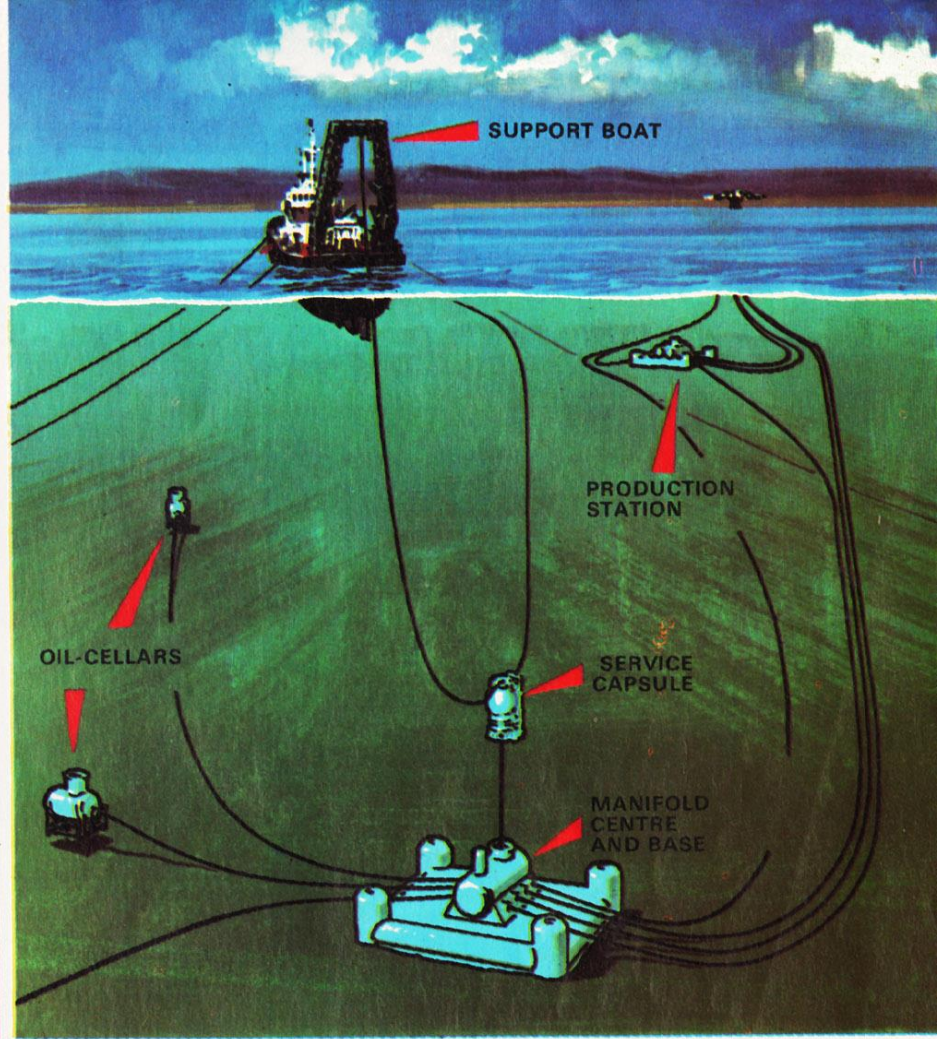
OIL-WELLS ON THE SEA-BED

Mediterranean, passing through Jordan, Syria, and Lebanon.

In Canada there is a 2,000-mile pipeline from Alberta to Toronto. The Trans-Alpine line in Europe carries oil from Trieste across the Alps to a refinery in Ingolstadt in Bavaria. The South European pipeline runs from the Mediterranean coast of France to the Upper Rhine area. Now the Soviet Union is planning to build a 2,500-mile pipeline from Irkutsk to the port of Nakhodka on the Sea of Japan.

Oil-tankers account for more than a third of the world's merchant shipping, and the heavyweight wonder of the oil transport business is the giant super-tanker, called VLCC (Very Large Crude Carrier).

Long enough to take three football pitches on its deck space,



In the not-too-distant future, the oil-rigs of the North Sea may be things of the past. For, by 1975, trials will be under way with a new system, in which the drilling is carried out on the sea-bed itself.

Lockheed Petroleum Services are already pressing ahead with advanced development work in the Gulf of Mexico, and a well has been drilled in nearly 60 metres of water. At the wellhead is what they call a "manifold centre and base". This is connected to "oil cellars" under the sea.

All these undersea installations can be reached and serviced by men diving in a pressurised vessel. This "capsule" (seen above left) will enable the servicing crew to transfer to or from the various parts of the system at atmospheric pressure. On coming to the surface, of course, there will be no necessity for the decompression which is necessary in ordinary diving.

The undersea storage system can be connected by pipeline either directly to the shore, or to a buoy at the surface, at which tankers will be able to load.

The advantage of the new system is the elimination of the conventional offshore drilling-rig with its dangers to the crews and to the actual drilling equipment. With the new system, all that will be necessary at the surface will be support craft acting as a base for the servicing crews and carrying spares and equipment.

Lockheed say that trials of this system are planned for the North Sea oilfields in 1975. The ultimate depths they hope to reach with the new system are in the region of 1,000 metres.

the VLCC is equipped with every modern radar and safety device. It is manned by a crew numbering under 40 men.

Twenty years ago tankers of 32,000 dwt (dead-weight tonnage, which refers to the carrying capacity) were regarded as being "super". By comparison with today's mammoth VLCC's of 200,000 to 500,000 dwt, they are indeed small fry. Even million dwt tankers are being designed for the future!

Another source of fuel is the rock known as shale. It is processed by crushing and "cooking" to produce oil similar to crude petroleum. The high cost involved, and the risk of harm to the environment, has discouraged production; but now the United States are to start exploiting the huge shale deposits in the Rocky Mountains region.

World of Wonder

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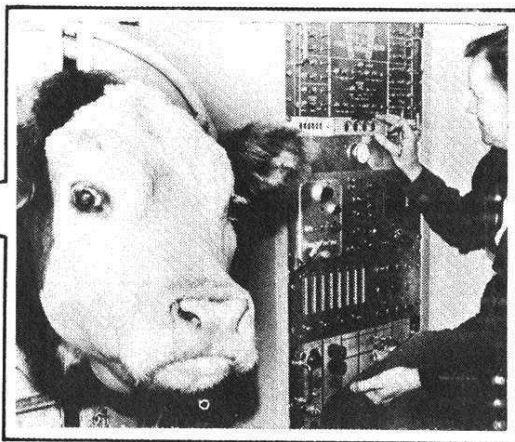
Down On The Farm = Of Tomorrow

See page 13



Down on the Farm - of Tomorrow

Scientists believe that to meet the world's ever increasing demand for food, farming will have changed beyond recognition by the 21st century



Left: a high-rise building to house farm livestock of the next century. Above: within the building a technician uses a portable "consulting room" to check a cow's health and condition. Below: lambs, no longer kept in fields, are fed automatically in their pens.



Earlier this year farmers, agricultural engineers and scientists from the great food-producing countries of the world met in the USA to discuss the future of agriculture. According to the report published after the conference, the farm of the 21st century will have little resemblance to the ones we know today.

By the year 2000, farms will be much bigger than they are today, but they will employ fewer workers because machines and electronic devices, many of which are already being tried out, will do the work of men's hands. As a result, farm workers will be skilled and highly paid technicians.

The farmer himself will no longer have to go out in all weather tramping about muddy fields to inspect his fields and growing crops. Instead, he will sit in a control room at the centre of his farm.

Closed-circuit television screens will give our farmer of the future a constant picture of all that is going on in the fields and buildings. Two-way radio will enable him to give orders to his workers, discuss with them any problems that arise, and order equipment to be moved to the exact places where it is needed.

Robot machines, some of them remotely-controlled from the farm's nerve centre by the farmer or his assistants, will move backwards and forwards across the fields planting the crops. At the rear of these machines, a series of drills will make holes of the necessary depth and accurately spaced apart. Mechanical fingers will then lift

from trays on the machine the seeds or plant shoots and deposit them in the holes. A second bank of fingers will stretch out from the machine and cover the shoots or seeds with earth.

All information about the crops will be fed into a computer. When the computer indicates that a crop is ready for harvesting, another machine will be sent to cut or lift the crop. Some of these machines will be equipped to fertilise the ground and prepare it for sowing immediately after the harvest has been gathered.

The growing and harvesting of crops will be made independent of the weather by covering large areas of farmland with plastic sheeting in the form of huge domes, which will be supported by air pressure within them.

The domes will be transparent to admit sunlight, while the atmosphere inside them will be automatically maintained at the conditions most suitable for the growing crop.

Progress of the crops growing within the domes will be registered on various measuring devices. These will be in electrical contact with dials and gauges in the farm control room. Simply by reading the information on the dials, the farmer will be able to activate devices which will raise or lower the temperature in the dome, increase or decrease the amount of light reaching the crops, and control watering and moisture.

Even the open fields will be largely independent of the weather in the year 2000. Electric cables buried in the

Traditional farm buildings will have no place on robot farms of the future

ground, something like the elements of an electric fire, will keep the earth at the right temperature for healthy plant growth. Lack of rain will be countered by spraying the crops either with sprinklers or from hovercraft tankers.

Most of the traditional farm buildings will have disappeared by next century. Instead there will be many-storeyed buildings rather like high-rise blocks of flats.

Belt Feeding

These high-rise farm buildings will house the farmer's cattle, sheep, pigs and poultry. Feeding of the stock will be by conveyor belts moving from floor to floor, and temperature, fresh air, light and humidity will be controlled automatically.

Waste products from the animals in the high-rise buildings will flow through pipes to a disposal or recycling plant. There the liquids will be purified and used to irrigate the crops, while the solids will be converted into fertilisers.

Most of the crops with which we are now familiar will be grown in the next century. But the plants will mature and

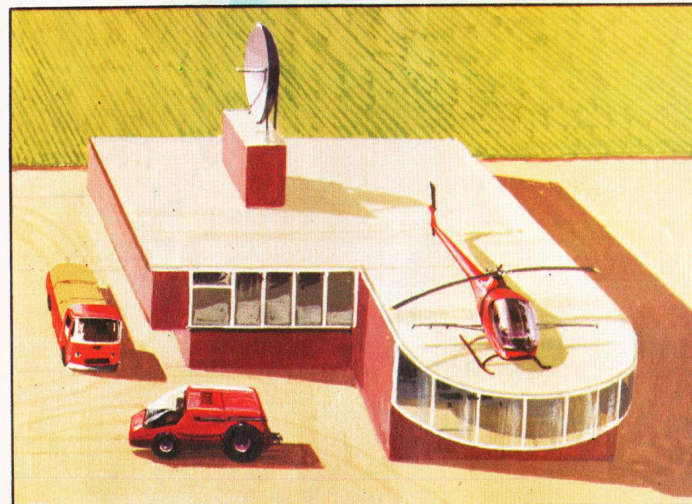
grow much faster. This will enable two or three crops a year to be grown where now it is possible to harvest only one.

Seed for wheat and other grain crops will be chemically treated to increase their proteins and, therefore, their food value. The seeds will also be treated with fertilisers before they are planted and they will have a built-in resistance to insect pests.

Crops grown from the 21st century tailor-made seeds will have been designed to flourish on only a fraction of the water needed by crops today. Such crops will be much less affected by drought.

Breeders are now working on improved strains of cattle, pigs, sheep and other livestock which by next century will result in animals being ready for market in a faster time than is needed today, and on less feedstuffs. Selective breeding will have resulted in the farmer having cows producing much greater quantities of milk than is yielded by today's dairy herds.

Veterinary scientists anticipate that by next century foot-and-mouth, swine fever, and the other diseases which now take such heavy toll of livestock will have been eliminated.



Above: the nerve centre building of a farm of the future. Below: an artist's impression of a large field covered by a dome of transparent sheeting, allowing crops to be grown in a man-made environment. To the left of the dome is the power house containing the compressors which keep the dome inflated.

Agricultural engineers are working on vastly improved farm machinery. By next century the farm tractor, for example, will have been completely revolutionised.

Some of the new tractors will be completely-automated robots without a human driver at the controls.

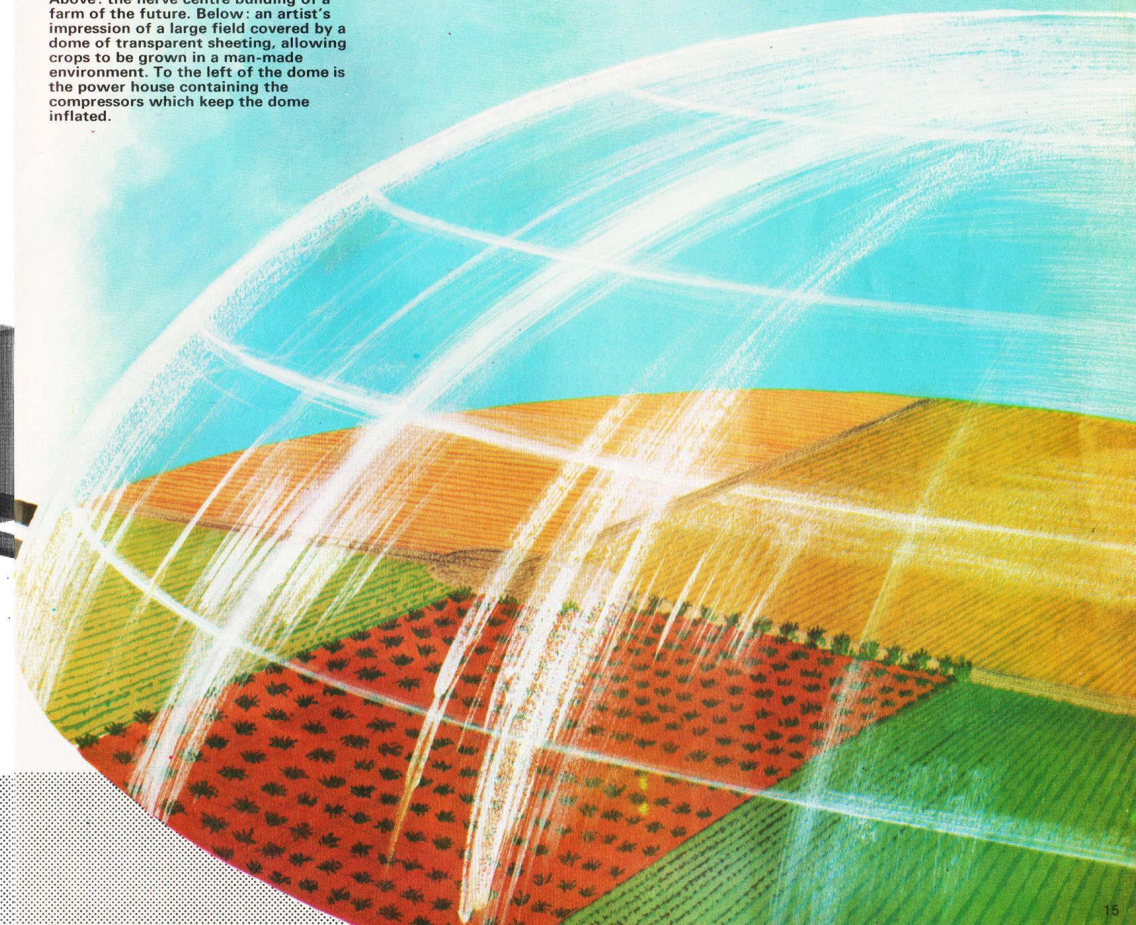
It is probable that by next century the internal-combustion engine will have disappeared from the farmlands. The vehicles will be electrically powered by storage batteries, fuel cells, or even by radio-transmitted electric power.

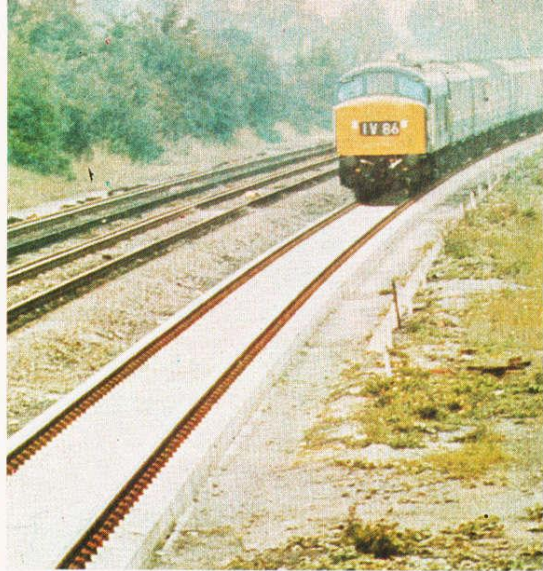
Even space science will be helping the farmer of the future. Orbiting the world's agricultural lands there will be special satellites collecting weather data, watching for possible threats to crops and tracking swarms of insect pests.

All this information will be radioed from the satellites to a central computing section. There it will be sorted out according to the districts concerned and sent by teleprinter to the farmers sitting at their control consoles.



Left: the farmer's control room on a robot farm of the 21st century. A television screen allows him to view his entire farm without leaving his chair. Push-button controls readily to hand allow various operations and machines to be started and stopped.



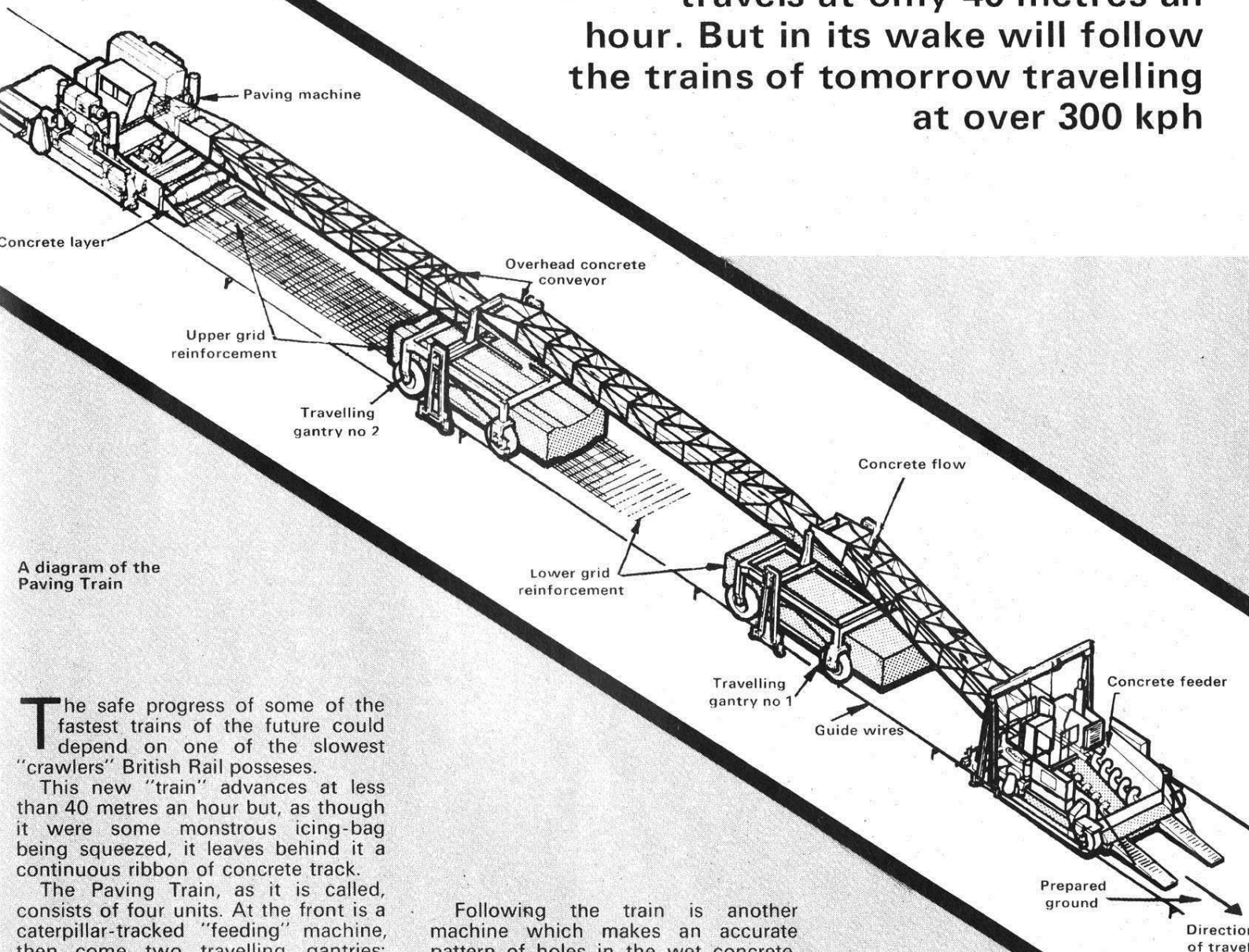


SLOW TRAIN FOR FAST TRACKS

Above: a section of the continuous concrete track in use. Below: steel grids being placed in to position. These provide reinforcement for the concrete poured over them. Below right: the formed concrete being levelled.



Like a huge mechanical snake it travels at only 40 metres an hour. But in its wake will follow the trains of tomorrow travelling at over 300 kph



A diagram of the Paving Train

The safe progress of some of the fastest trains of the future could depend on one of the slowest "crawlers" British Rail possesses.

This new "train" advances at less than 40 metres an hour but, as though it were some monstrous icing-bag being squeezed, it leaves behind it a continuous ribbon of concrete track.

The Paving Train, as it is called, consists of four units. At the front is a caterpillar-tracked "feeding" machine, then come two travelling gantries; and at the rear is the paving machine, normally used for laying sections of new motorway. This also carries the motors that drive the train along.

Ready-mixed concrete is brought by trucks and dumped into the feeder, from which it is carried on a conveyor belt over the gantries and into the paving machine at the rear.

As the train moves forward, the first gantry lowers a section of steel reinforcement grid on to the ground. The second gantry, some 16 metres behind, then lowers another section on top of the first and the two are welded together to form a continuous run of mesh.

As the paving machine passes over the continuous grid it engulfs it in the concrete it spreads. The resulting never-ending slab of reinforced concrete is of immense strength.

Following the train is another machine which makes an accurate pattern of holes in the wet concrete. Once the concrete is dried, track fastenings can be fixed into the holes, the rails laid, and all is ready for the trains to start using the track.

The advantages of this type of railway line are numerous. The initial maintenance costs are low. Its stability guards against buckling and heat distortion of the long welded rails which are laid on the concrete base. And because it has no hollows or bumps high speed trains will not sway or rock as they can do on conventional track.

Although the train looks cumbersome (it is as long as five buses) it can operate alongside existing track carrying express trains and not hinder their scheduled runs.

So far, only four kilometres of experimental track have been laid in Britain; the last section was put down in

Glasgow, in 1973. It is used by existing services—including the 160 kph Inter-City trains. But the great value of the track will be proved when such trains as the projected Advanced Passenger Train, which can reach speeds of 300 kph, come into service.

It is likely that this type of track will be used if and when a Channel Tunnel railway is constructed. Meanwhile, the track-laying train is soon to be sent to New Zealand to demonstrate its unique ability to lay high speed track.

Photos and drawing : British Rail

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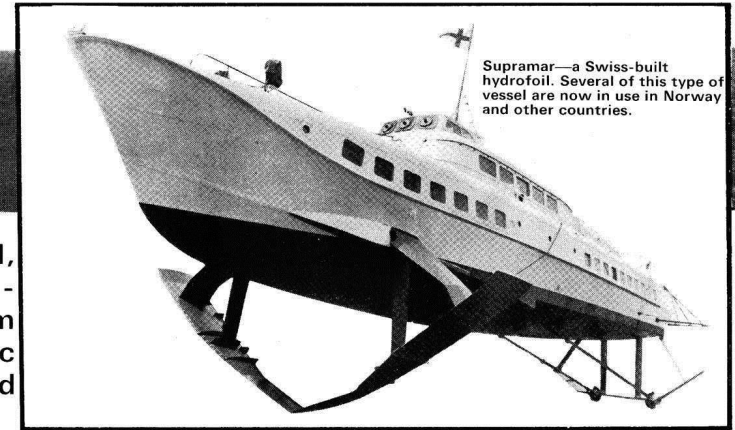
GET-UP-AND-GO SHIPS

See page 12



SHIPS THAT GET UP AND GO

Italian-built hydrofoils like this are used on passenger service runs across Norwegian fiords.



Supramar—a Swiss-built hydrofoil. Several of this type of vessel are now in use in Norway and other countries.

In tomorrow's world, hydrofoil ocean-liners may skim across the Atlantic at express speed

Just as the railways must increase the speed of express trains if they are to compete successfully with the airlines, so must ocean-liners travel faster if they are to regain the traffic they have lost.

In their constant search for higher speeds at sea, marine engineers are designing ever more powerful and efficient engines. But the fastest ocean liner is still many times slower than the average airliner.

This is certainly true of travel between Europe and America. The fastest ships take days to make a journey across the Atlantic which an aircraft can complete in a matter of hours.

Faster and more powerful engines could never increase the speed of the fastest ocean liner much above that of today. The friction between a ship's hull and the water through which it is travelling must always act as a brake on the conventional ship's speed.

Friction between water and hull creates what is called drag or resistance. Drag becomes greater the bigger the ship. It can be reduced by careful streamlining of the hull and putting more power into the propellers that drive it.

Nevertheless, streamlining and greater engine power do not completely

solve the problem. The only solution is to lift as much of the ship as possible out of the water.

One of the earliest attempts to put that solution into practice was the stepped hull used for high-speed motor-boats.

With this type of boat the hull is stepped down towards the rear, so that at speed the bow rises out of the water. The boat then travels with only the step below the stern in contact with the water.

You can see this in action when a speed-boat cuts through the water with its bow high in the air. It is achieving high speed because only a small part of the boat's hull is in contact with the water to create resistance.

The next leap forward in the ever increasing search for high speed on the water was to lift the hull right out of the water. The vessel then becomes a hydrofoil and skims over the surface of the water supported on skis.

With a hydrofoil boat, water resistance is cut to a minimum and the chief source of drag or opposition to the movement of the hull comes from the air. At any foreseeable speed for hydrofoils, air resistance is still considerably less than that of water.

Although it is only recently that the hydrofoil has been seriously considered by marine engineers, the idea of putting ships on skis is by no means new.

In fact the hydrofoil principle was first put into practice as long ago as

1887. That year a French engineer named Lambert built the very first hydrofoil and tried it out on the River Seine.

In 1906 Enrico Forlanini invented a hydrofoil which he drove across Lake Maggiore at a speed of nearly 40 knots. That speed was bettered

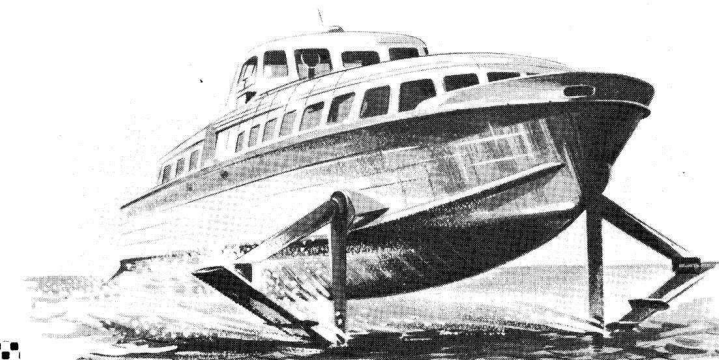
in 1919 with a Hydrofoil built to the design of Alexander Graham Bell, the inventor of the telephone.

All these early hydrofoils were very unstable. They tended to lose their balance and topple over at speed. Unless the water was absolutely smooth, there was always the risk of the

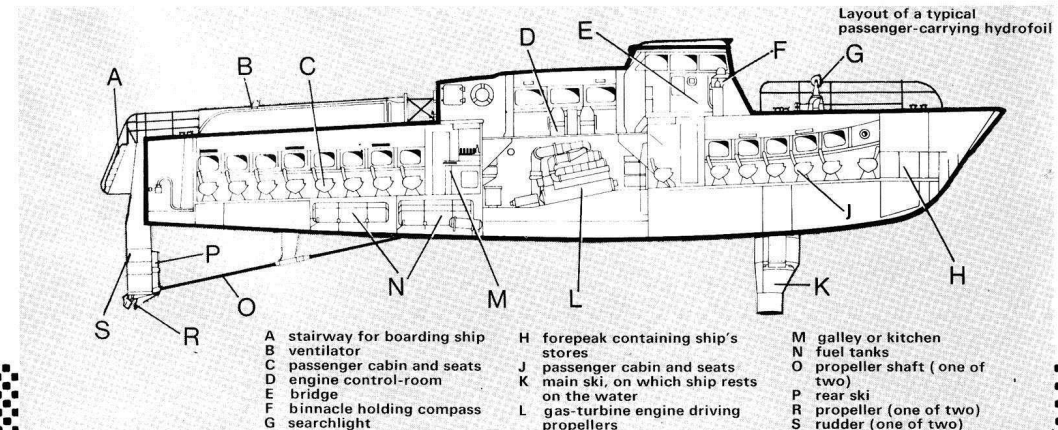
struts supporting the skis breaking.

During the next 50 years a number of hydrofoils of improved design were designed and built. But they were never more than fair-weather craft used for water sports.

During the past ten years, however, a number of countries have become

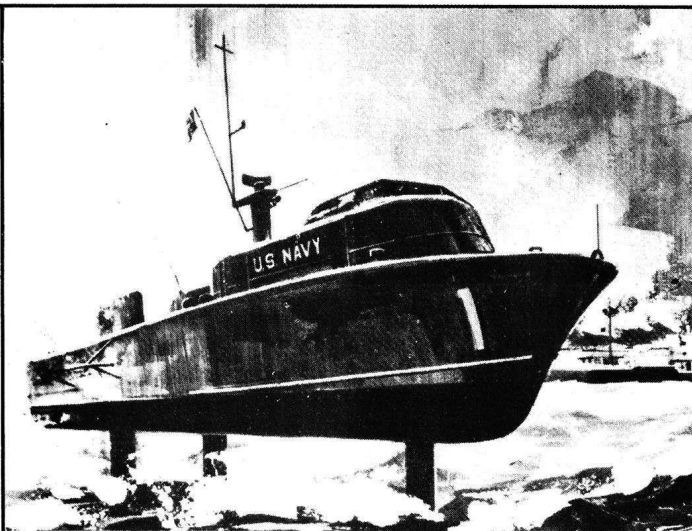


Right: the largest smooth-water hydrofoil now in service. Built and operated in Russia, this 107-ton craft can carry 300 passengers, but is not suitable for ocean-going voyages.



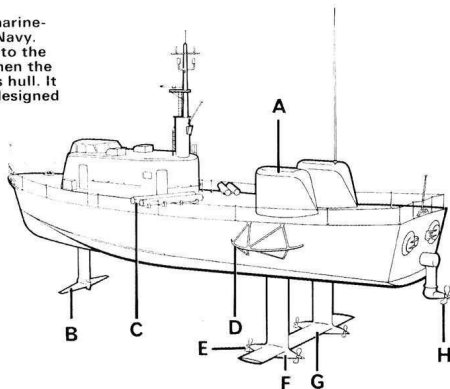
Layout of a typical passenger-carrying hydrofoil

- | | | | | | |
|---|----------------------------|---|--|---|------------------------------|
| A | stairway for boarding ship | H | forepeak containing ship's stores | M | galley or kitchen |
| B | ventilator | J | passenger cabin and seats | N | fuel tanks |
| C | passenger cabin and seats | K | main ski, on which ship rests on the water | O | propeller shaft (one of two) |
| D | engine control-room | L | gas-turbine engine driving propellers | P | rear ski |
| E | bridge | | | R | propeller (one of two) |
| F | binnacle holding compass | | | S | rudder (one of two) |
| G | searchlight | | | | |



Above: a hydrofoil submarine-chaser built for the US Navy. The hydrofoils retract into the housings on the deck when the vessel is travelling on its hull. It is powered by a British-designed Proteus gas engine.

- Details of the US Navy hydrofoil illustrated above.
- A cover for the retracted hydrofoil struts
 - B forward foil
 - C torpedo tubes
 - D bumper
 - E propeller
 - F nacelle
 - G aft foil
 - H propeller for use when ship is in hull-down position



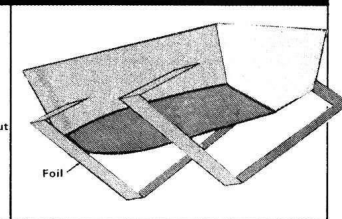
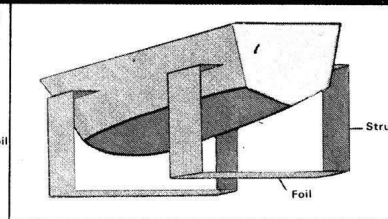
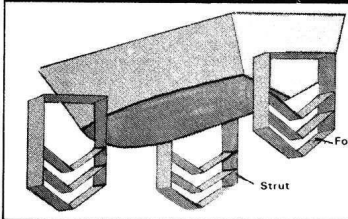
Some of the early hydrofoil boats had "ladder" foils. As the boat gathers speed it lifts and runs on each pair of wings in turn. At full speed it is travelling on the lowest pair of wings, and the others are clear of the water. The fully submerged hydrofoil has two advantages. As the foils run below the surface of the water, they are not affected by waves and the variations in "lift" that the waves cause. Also, by setting the foils

on long struts, the boat can be made to travel at a height when most waves will pass underneath the hull without touching it. This ensures a steadier ride at sea. Surface piercing foils are self-stabilising. This means that if a wave causes the boat to heel over, the shape of the foils automatically compensates for the movement by pushing against the water. Acting rather like the wing of an aircraft, the foil will lift the boat back upright again.

LADDER TYPE

FULLY SUBMERGED

SURFACE PIERCING



interested in the hydrofoil and sponsored the building of ski-ships as fast passenger and cargo ships.

As a result there are regular hydrofoil services on the French and Italian Rivas, between Venice and Trieste, between Athens and some of the Greek islands, and between Sicily and the Italian mainland. Russia has built the biggest smooth-water hydrofoil now in service. This is a 107-ton craft with accommodation for 300 passengers. Although many of these craft now in service can reach speeds of 40 knots they are all smooth-water craft and none is suitable for ocean-going voyages.

The first ocean-going hydrofoil was designed and built for the United States Government. This vessel, the *Denison*, is nearly 32 metres long, six metres wide, weighs 80 tons, and the gas engine driving her propeller gives the vessel a top speed of 80 knots. She carries a payload of 37 tons.

Hitherto all hydrofoil vessels have had fixed skis on which they glide over the water. These are ideal for smooth inland water and the vessel travels on an even course as long as the foils are on the surface of smooth water.

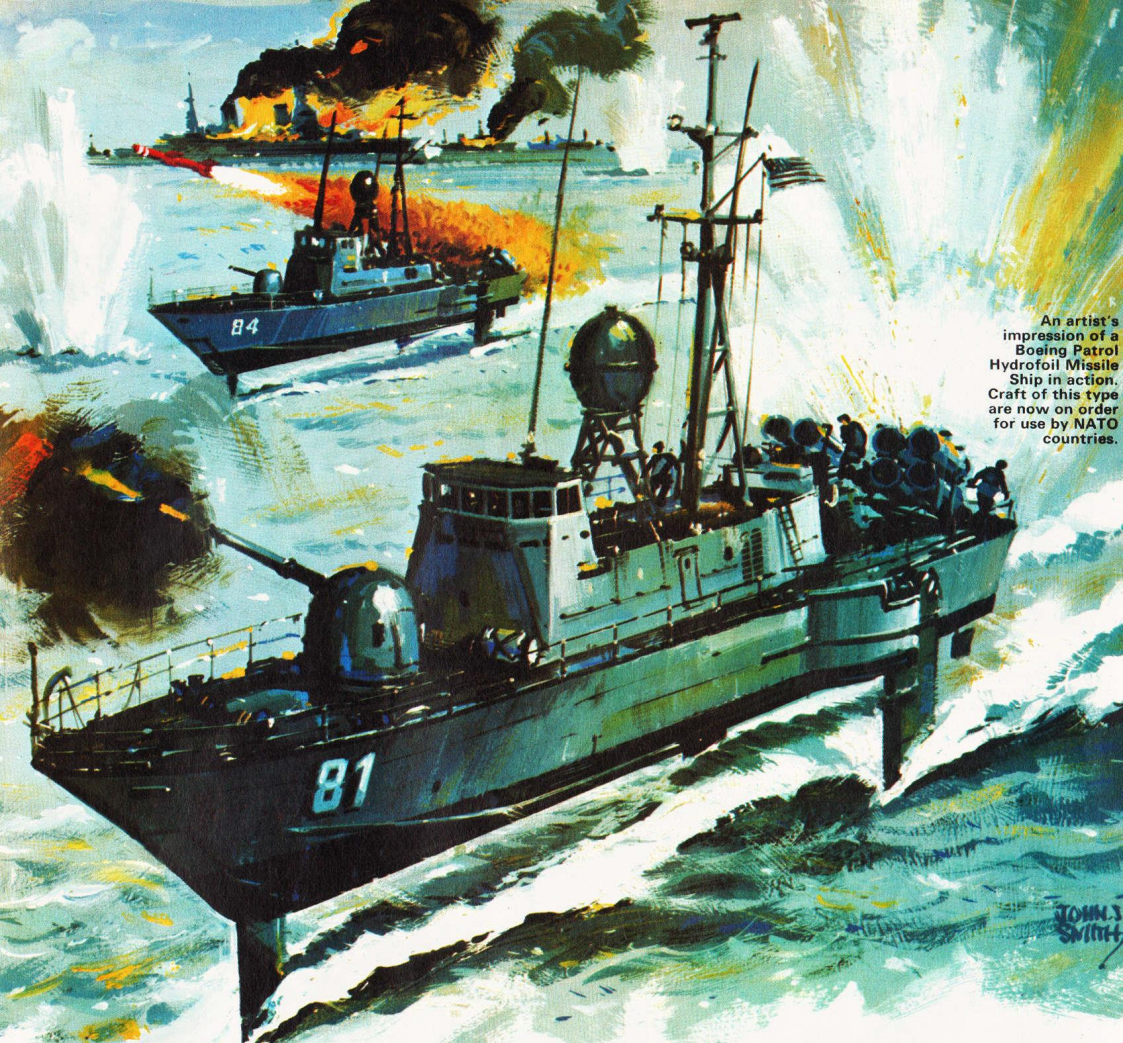
Bumpy Journey

The disadvantage of the fixed foil is that it follows the ups and downs of the swells and waves encountered on the sea. The result is a bumpy and uncomfortable journey and the vessel is unsteady and liable to overturn at high speed.

The *Denison* is able to travel safely on the open sea because she is mounted on moveable foils instead of fixed ones. An automatic device instantly senses the beginning of any rolling, heaving or pitching, and forestalls these movements by making continuous adjustments to the forward foils.

As a further safety measure, the *Denison's* foils can be folded up against the side of the ship in rough weather so that she floats solidly on her hull. Folding the foils also makes it easier to manoeuvre the vessel in docks and crowded harbours.

Sea-going tests of the *Denison* proved so encouraging that American marine engineers have designed a mini hydrofoil-liner of 600 tons, able



An artist's impression of a Boeing Patrol Hydrofoil Missile Ship in action. Craft of this type are now on order for use by NATO countries.

The Boeing Aerospace Company's first jetfoil boat, which on high-speed tests reached speeds of 37 knots. It is soon to start tests in the Pacific Ocean at speeds up to 45 knots.

to carry 150 passengers at a speed of 100 knots. A one-sixth scale model of the ship has been built and successfully tried out in the open sea.

Next the United States Navy became interested in the hydrofoil as a fast torpedo-boat and submarine-chaser. The first of these vessels is the *High Point*.

The *High Point* is 36 metres long, nine metres wide and displaces 110 tons. The ship has a crew of 14 officers

Continued on page 26



World of Wonder

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AGE
OF THE
**SUPER-
BLIMPS?**
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11th January 1975

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SUPER-BLIMPS

When the giant airship Hindenburg plunged to the ground in flames, nearly 40 years ago, airship development was abandoned. Now it looks as though the airship is coming back—bigger, better, and much safer

Cargo airship of the future? This British-designed monster, the MACS (Merchant Airship Cargo Satellite) would never leave the air. Smaller airships would ferry cargo containers to it from the ground.

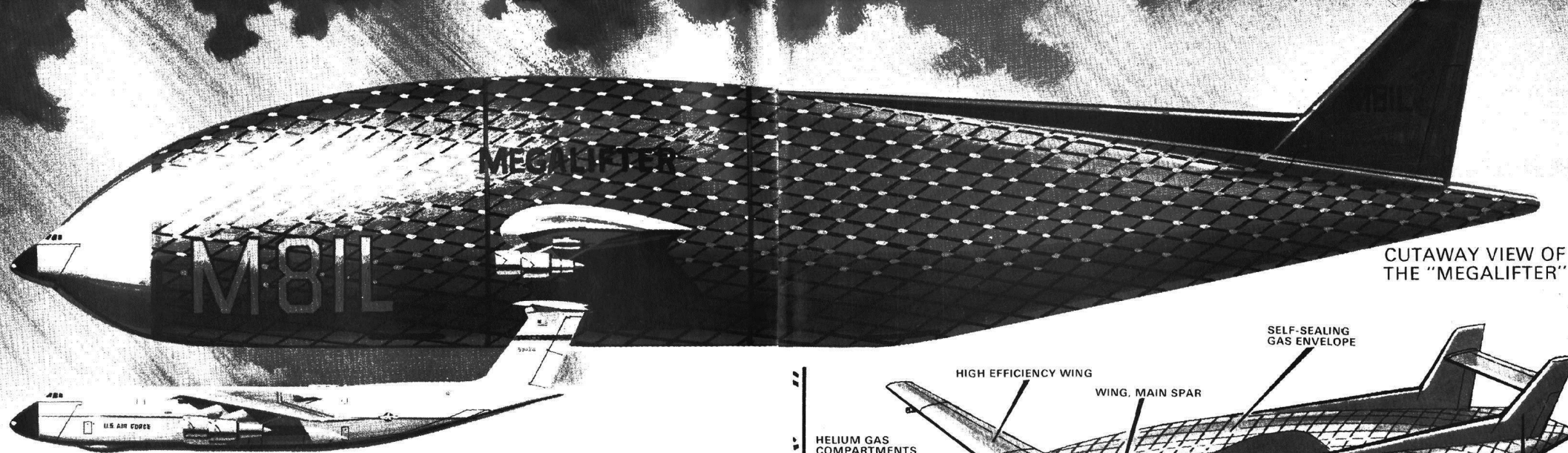


It is night time at Le Mans, and the famous 24-hours sports car race is in progress. High above the circuit a large dark shape hovers in the sky. It is the Goodyear airship *Europa*, whose flashing night sign of electric lights gives the spectators below the latest positions of the racing cars.

The *Europa* and her three sister-ships of the Goodyear Tyre and Rubber Company are the only dirigibles in constant operation today. A dirigible is a lighter-than-air craft that is engine-driven and steerable.

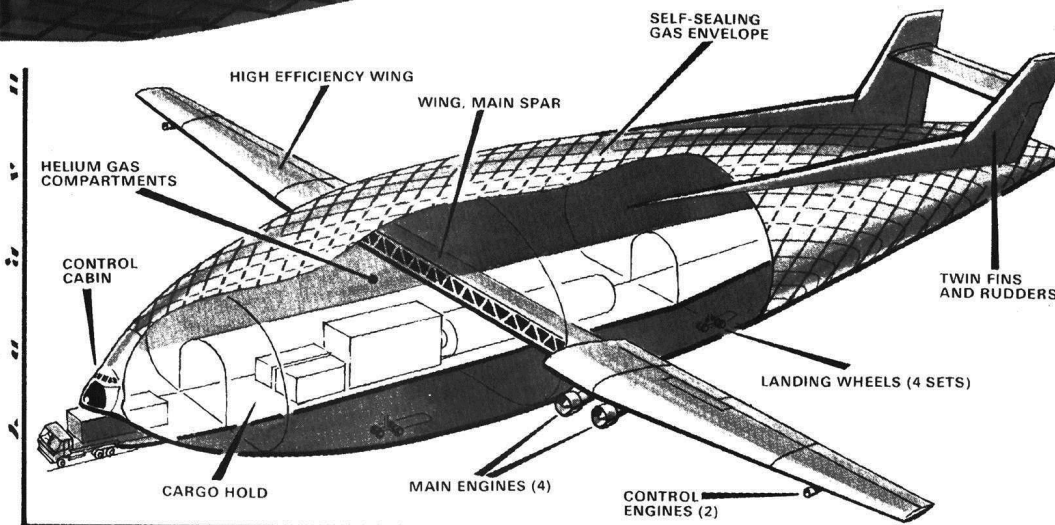
Based at Capena in Italy, the *Europa* serves as an "Aerial Ambassador" and flies over Europe every year on advertising and goodwill missions. Her "Super Skytacular" night sign, composed of thousands of coloured lights activated by computerised tape, displays public service messages on energy conservation, public health, safety and local charity news.

The *Europa* is also used as a television platform and it was used to cover the World Cup at Munich, the Le Mans race in France, and the German



CUTAWAY VIEW OF THE "MEGALIFTER"

Above: propelled by jet engines, and able to carry 200 tons of cargo, the vast American-designed Megalifter, as compared with the world's largest transport plane, the Lockheed C-5A Galaxy (same scale). Parts of the Galaxy, including its landing-wheels, cockpit and nose, have been incorporated into the Megalifter design.



Grand Prix of 1974. This small airship cost £1½ million to build and is manned by an international team of 22, with a fleet of six vehicles to accompany her on her visits.

Could the successful operations of the *Europa* (of limited use though it is) mark the beginning of a new age of airships? Will the giant dirigibles ever return? Many airship enthusiasts think they will. But a number of aviation experts firmly believe that the airship will never make a commercial comeback.

The golden age of airships ended in 1937 when Germany's great skyliner *Hindenburg*, over 243 metres long, had been the pride of Germany, the largest and most luxurious of her commercial airships, with more than 30 successful transatlantic crossings to her credit.

The *Hindenburg* disaster followed the loss of other giant dirigibles by Britain, America, and Italy. So airship development was abandoned in favour of the aeroplane.

The biggest hazard of the old airships was in the use of highly inflammable hydrogen gas as the lifting agent. If the

airships had been filled with the safer helium gas they would never have burst into flames. Helium has nearly as much lifting power as hydrogen and it does not catch fire. But in the 1930s helium was in short supply. Today it is plentiful, but expensive.

The helium factor, and the great advance in technology, adds considerable weight to the argument of the airship advocates, who see giant dirigibles as bulk freight carriers of potential importance. Airships, they say, could fly above the crowded surface transport systems and deliver and collect large amounts of cargo "door-to-door" anywhere in the world.

Over the last ten years various plans have been put up in the United States and Britain for the design and operation of huge freight- and passenger-carrying airships. The Aereon Corporation of America built and tested a small prototype of revolutionary design which

had three airship hulls joined together. Then the company ran short of money and the Aereon was not developed.

The Goodyear company, which had built many big American airships between the world wars, introduced their "Aerial Ambassadors" in the late 1960s; the *Europa* was built in England in 1972. These Goodyear airships are the non-rigid type in which the envelope shape is maintained entirely by the internal pressure of the helium-lifting gas. There is no internal framework.

Nuclear Craft

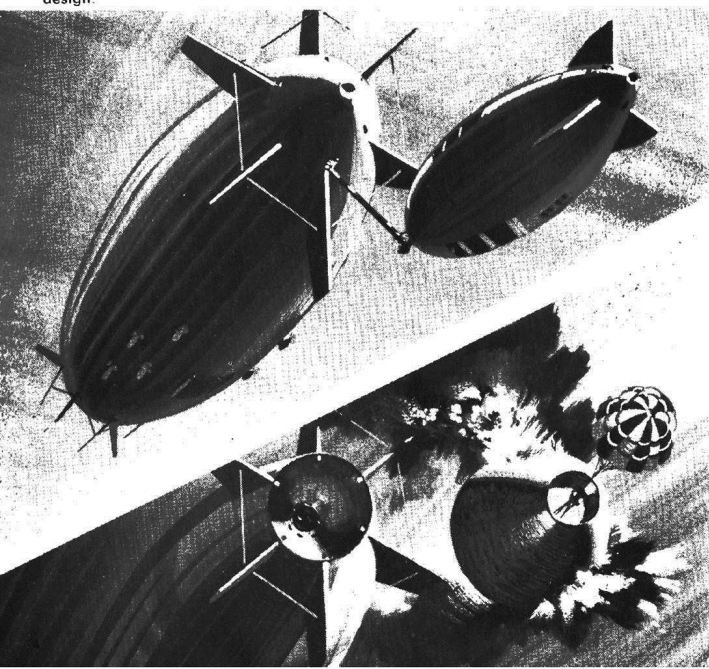
However, the *Europa*, with a length of 58.5 metres, is a small fish compared with the size of other designs which have been put forward in recent years. Professor Morse of America has produced a design for a nuclear-propelled rigid airship nearly 299 metres long.

This monster would be able to lift 340 tons and have unlimited range. It could carry 400 passengers in great comfort and house an 18-passenger aeroplane for ferrying people to and from the airship while it was still in flight. But the Morse skyliner has not yet advanced beyond the drawing board.

A British company called Airfloat Transport was formed recently to promote the "Airfloat HL" (Heavy Lift) airship designed by Dr Edwin Mowforth. This helium-filled colossus would be nearly 366 metres long and able to carry 400 tons over 2,414 kilometres (1,500 miles). Driven by turbo-prop engines it would cruise at 145 kph (90 mph) at a height of 457 metres.

The Airfloat HL would be used as a general-purpose freight-carrier transporting goods in cargo modules directly between factories and marketing points. It could also carry 250 cars and 1,000 passengers as a cross-Channel ferry.

This heavy-lift airship, designed by British firm Airfloat Transport, could use aviation kerosene or natural gas as fuel and if the latter, it would be towed behind in a smaller "blimp" (upper picture). An extra supply of fuel carried in a tail cone tank, for use when changing from an empty blimp to a full one, could be quickly jettisoned in case of fire.



accepted Mohammed's assurance that henceforth there was only one god, Allah, before whom rich and poor were equal.

The wealthy officials of Mecca were not impressed with the idea of a new preacher in their midst. As far as they were concerned, the idea of a faith under which all men were equal could only mean a threat to their own power.

Accordingly, they settled down to make things as uncomfortable as possible for Mohammed and his tiny band of followers. So uncomfortable, that when

he received an invitation to live in far-off Yathrib, or Medina, as it is now called, there seemed no point in refusing. Mohammed sent his followers on ahead of him, then he too reluctantly turned his back on Mecca and headed for what he hoped would be a fresh start.

To followers of Mohammed, the flight to Medina marks the official beginning of the religion of Islam—meaning, literally, "Submission to God". In Medina the community was torn by a feud between two Arab tribes who lived there. Because of this, Mohammed had no sooner arrived than he was asked to act as peacemaker. It was a task that gave him immediate political influence. Soon

he was both powerful and respected, and he spread his teachings at a remarkable rate.

Islam proved a faith with an immediate appeal. For one thing, it was exceptionally easy to understand, based as it was on five principles, the "Five Pillars of Islam": faith, prayer, almsgiving, fasting and pilgrimage to Mecca.

There was, Mohammed taught, but one god, Allah, whose prophet he was, as had been Adam, Abraham, Moses and Jesus before him. The complete faith was set down in a book, the Koran. Unlike most other religions, Islam required no lengthy ritual or training before a man could be accepted. One

had only to say in front of a Moslem: "I testify that there is no god but Allah and Mohammed is his Prophet," to embrace the new faith.

Fighting Faith

Although many of Islam's rules of conduct echo the Old and New Testaments of the Bible, the Christian teaching that one should forgive one's enemies is not found in the Koran. Indeed, Mohammed urged his followers to fight for their faith and promised eternal paradise to those who died while so doing.

This spirit of aggression accounted for the dramatic speed with which the

new faith spread. Welded together by a common bond, Mohammed's followers surged across the borders of neighbouring countries, eager to convert unbelievers—or slay them. It was a far cry from the persecuted Mohammed's flight to Medina, for a day would come when the Prophet's one-time handful of followers would number 250 million men and women throughout the Eastern world.

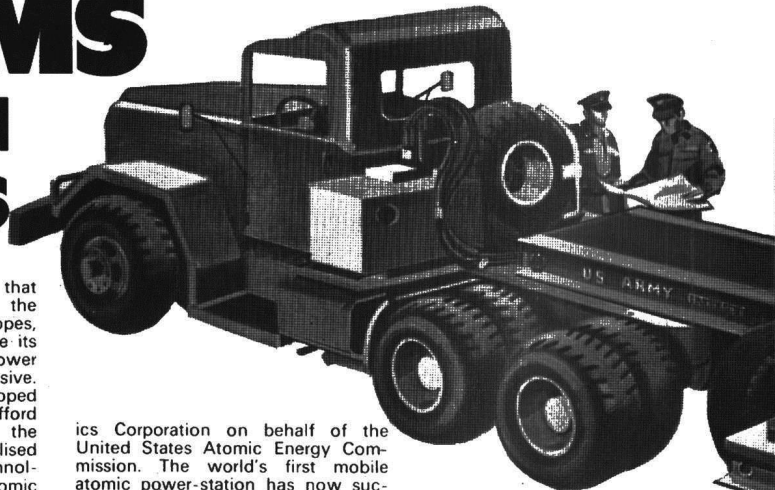
BUT WHAT WOULD HAVE HAPPENED IF... Mohammed had *not* fled to Medina?

In view of the feelings he had aroused, it seems likely that Mohammed would

have either been killed or imprisoned had he remained in Mecca. His followers would have been scattered, his new religion suppressed.

Had this happened, the huge Islamic Empire that eventually stretched from Spain in the West to India in the East would never have existed, completely altering the history and development of these lands. The world would have been the poorer for the loss of Islamic verse and architecture, and the Western countries would have had to learn to calculate without the help of algebra and Arabic numerals, and science itself would have been much slower in its development.

ATOMS ON WHEELS



Although the atom is so small that it cannot be seen under the most powerful of microscopes, the equipment needed to release its energy as a source of light and power is fantastically big and expensive.

That is why the under-developed countries of the world cannot afford to use nuclear energy. Only the wealthy and highly-industrialised nations have the money and technology necessary to harness atomic power.

Miniature nuclear power-stations weighing only a few kilograms have been put into orbit some of the satellites sent into orbit round the earth. But these mini-stations produce only the tiny amount of electricity needed to supply a few electronic tubes and other small devices. The total current derived from a satellite's nuclear power-station is equal only to that from half-a-dozen pocket-torch batteries.

What is needed to bring useful nuclear power to isolated communities without electricity are mobile atomic power-stations able to provide a continuous supply of current. Such a station would have to be easy to operate without the attendance of highly-skilled staff.

The first step in that direction was made by the Aerojet General Nucleon-

ics Corporation on behalf of the United States Atomic Energy Commission. The world's first mobile atomic power-station has now successfully undergone practical tests in several parts of the world.

Weighing just under 40 tons, the mobile nuclear power-plant can generate 330 kilowatts of current for 10,000 houses, operating continuously and without having to be refuelled. It can be carried on a trailer towed by a tractor, sent by rail, shipped by sea or flown by a cargo aircraft.

Heart of the power-plant is a reactor consisting of a steel cylinder filled with pellets of a metal called boron. The boron releases radiation which generates heat.

Heat from the reactor raises the temperature of a gas. When the gas is heated it expands and pushes against the blades of a turbine. The turbine drives a dynamo to produce electric current.

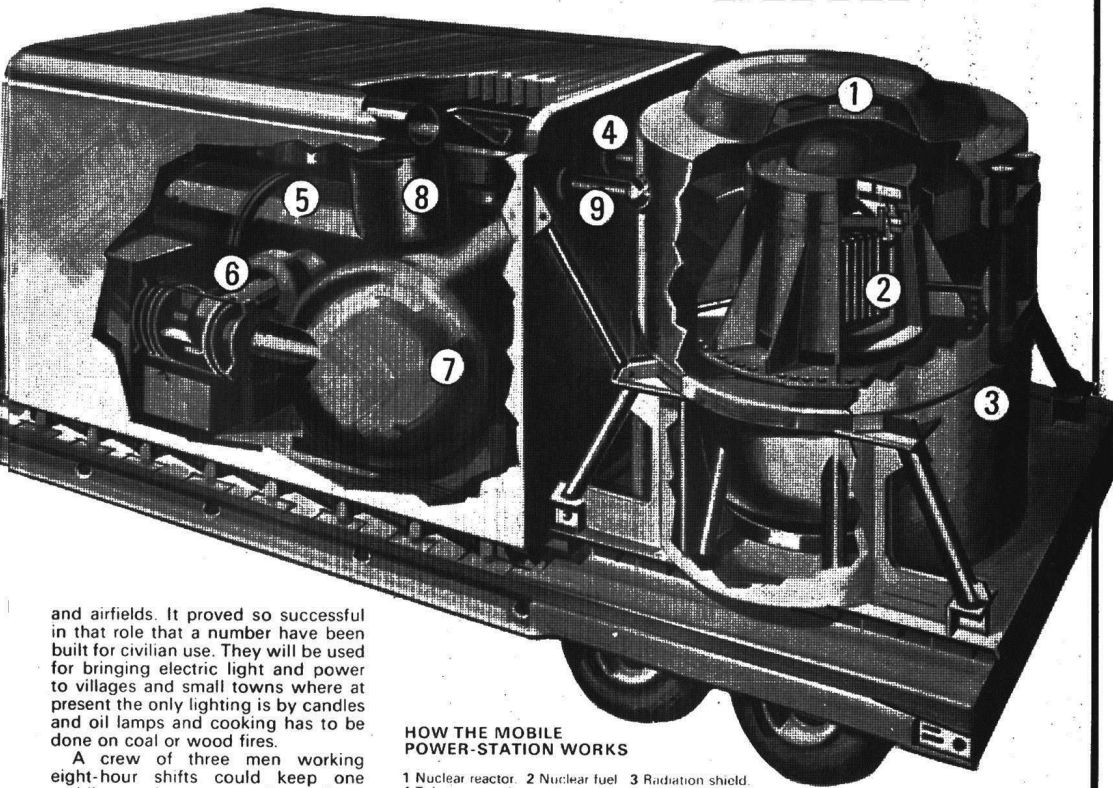
After the gas has passed through the turbine it is not wasted. Instead,

it passes through a device called a "heat exchanger", in which it is cooled. It then returns to piping surrounding the reactor where it is again heated to expand and drive the turbine.

One of the major problems of any form of nuclear power-station is the weight of the shielding needed to prevent the radiation from harming people in the vicinity. Normally the radiation is held in check by surrounding the reactor with thick walls of lead. These walls weigh hundreds of tons.

With the new mobile atomic power-station, the reactor is shielded by a series of tanks filled with liquid chemicals. These have the property of absorbing radiation.

The mobile nuclear-power station was originally designed for supplying electricity to isolated army workshops

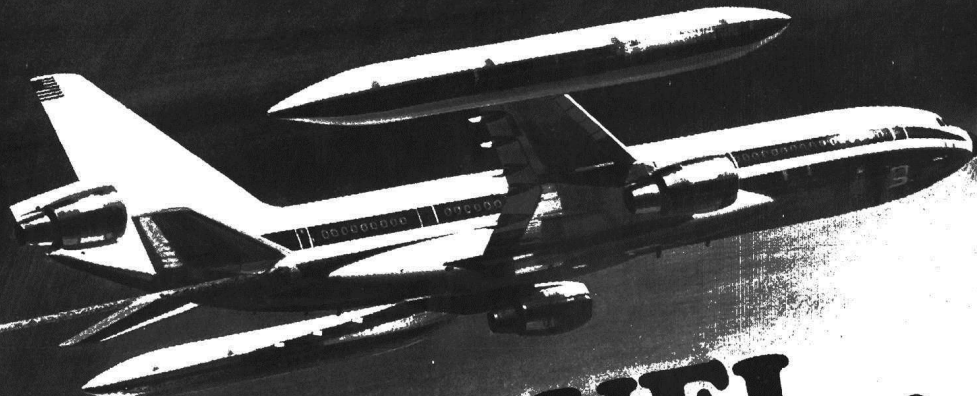


and airfields. It proved so successful in that role that a number have been built for civilian use. They will be used for bringing electric light and power to villages and small towns where at present the only lighting is by candles and oil lamps and cooking has to be done on coal or wood fires.

A crew of three men working eight-hour shifts could keep one mobile atomic power-station delivering a non-stop supply of current for a year before the reactor needed refuelling.

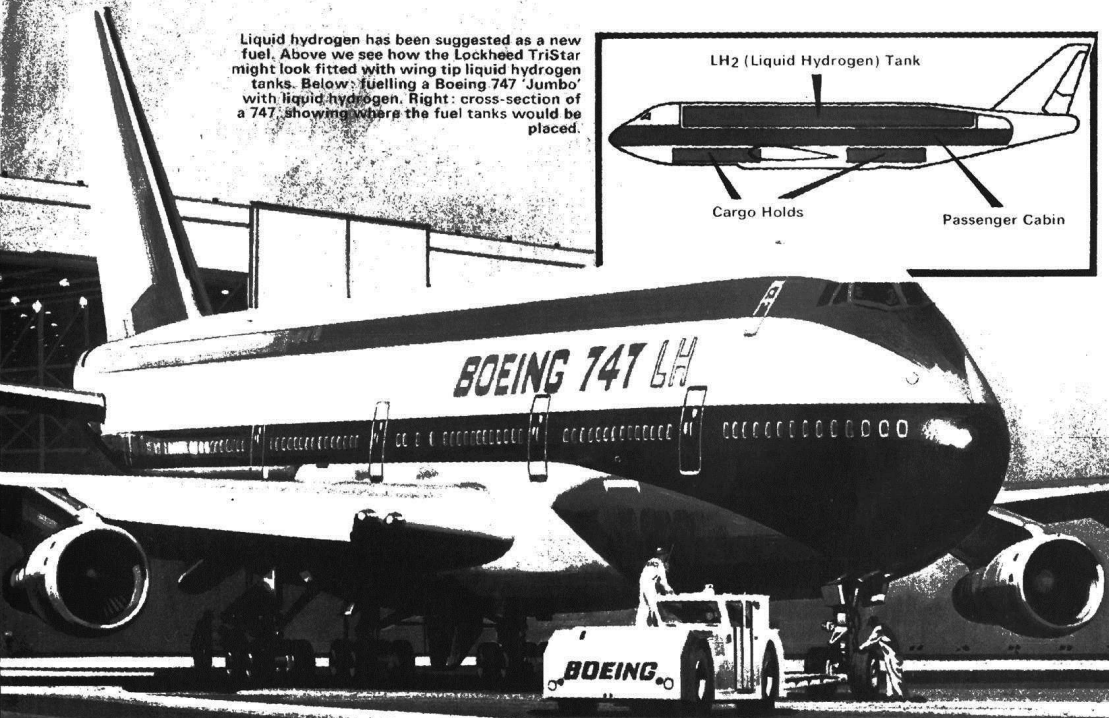
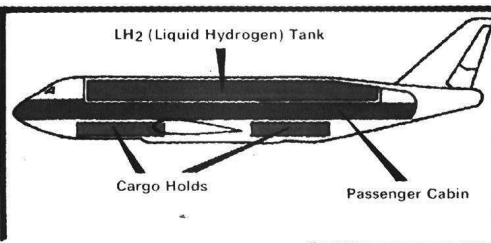
HOW THE MOBILE POWER-STATION WORKS

1 Nuclear reactor. 2 Nuclear fuel. 3 Radiation shield. 4 Tube carrying hot and expanding gases from reactor to turbine. 5 Turbine and electric generator. 6 Tube carrying used gas from turbine. 7 Heat exchanger, in which gas is cooled. 8 Air filter. 9 Tube carrying cooled gas back to reactor.



LESS FUEL... MORE SPEED

Liquid hydrogen has been suggested as a new fuel. Above we see how the Lockheed TriStar might look fitted with wing tip liquid hydrogen tanks. Below: fuelling a Boeing 747 'Jumbo' with liquid hydrogen. Right: cross-section of a 747, showing where the fuel tanks would be placed.



Fuel bills are among airlines' biggest problems. Cut them down—and air travel may get faster!

When next you see a Jumbo Jet hum its way across the sky above you, it's worth considering that it may be the last of its kind. The cost of fuel is so high now—it represents 30 per cent of all airline costs compared with 10 per cent only a year ago—that scientists are seriously considering radical changes in the design and operation of aircraft.

The fuel bill must be cut somehow, or it will one day send airline companies reeling out of business, and many would-be passengers will be well and truly Earthbound.

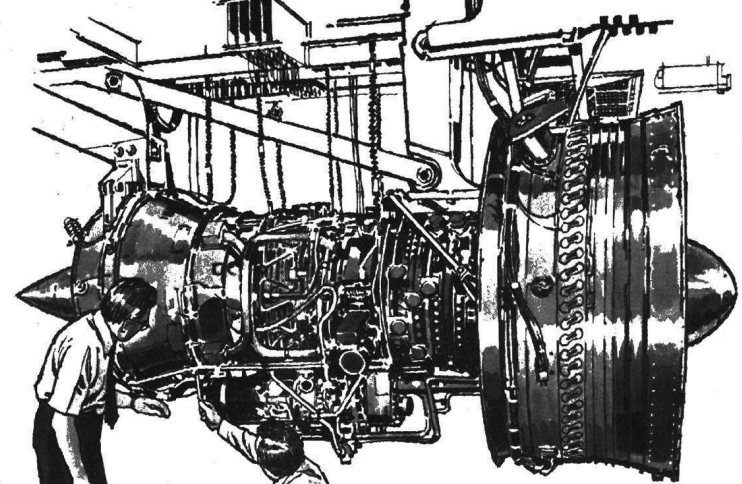
There are three basic solutions. Firstly, improve airliner operations; secondly, apply new technological developments to existing aircraft; and thirdly, explore new concepts, such as the use of hydrogen fuel and nuclear power or the development of a new kind of airship. All this points to a radical change in aviation as we know it.

Massive Savings

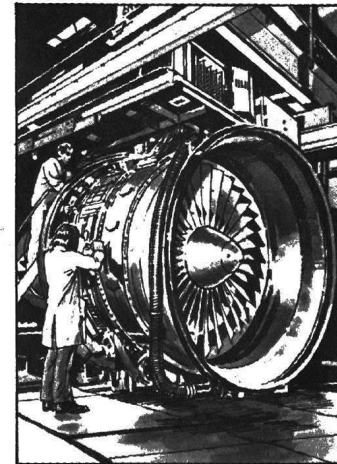
Scientists, designers and economists have come up with a number of immediate remedies to the aviation ills. For instance, by towing aircraft out to the end of the runway, massive savings can be made to the fuel bill. In America alone up to 1,700,000 litres could be saved daily—over 600,000,000 every year! This would also reduce air and noise pollution near to the airliner terminals.

New systems of guided landing now being developed will enable greater numbers of aircraft to land at an airfield in a given time. At present, aircraft waiting their turn to land may have to remain "stacked" in the air for considerable periods, wasting valuable time and valuable fuel. If this stacking time could be reduced, millions of litres of fuel could be saved.

The latest of these systems is known as MLS (Microwave Landing System). It is an automatic, computer-controlled system, which would enable the pilot



Above: the new Pratt & Whitney JT103 Commercial Turbofan Engine, claimed by its makers to give a 20 per cent improvement in fuel consumption over its predecessors in use today. Right: newest version of the Rolls-Royce RB211 engine, offering greater power with less fuel consumption.



to land his aircraft on the runway with the minimum of preliminary manoeuvring. The MLS system is being developed in different countries in different forms. Whichever form is finally accepted by the world's aviation authorities, it should streamline air-traffic control to such an extent that a rapid succession of landings will be possible.

By improving aircraft design and by using the lighter and stronger metals available, fuel savings can be made. In flight the "drag" of the airflow against the edges of the plane reduces its speed. By streamlining the design, the drag of an aeroplane can be reduced by pulling the airflow close to the wing and tail surfaces.

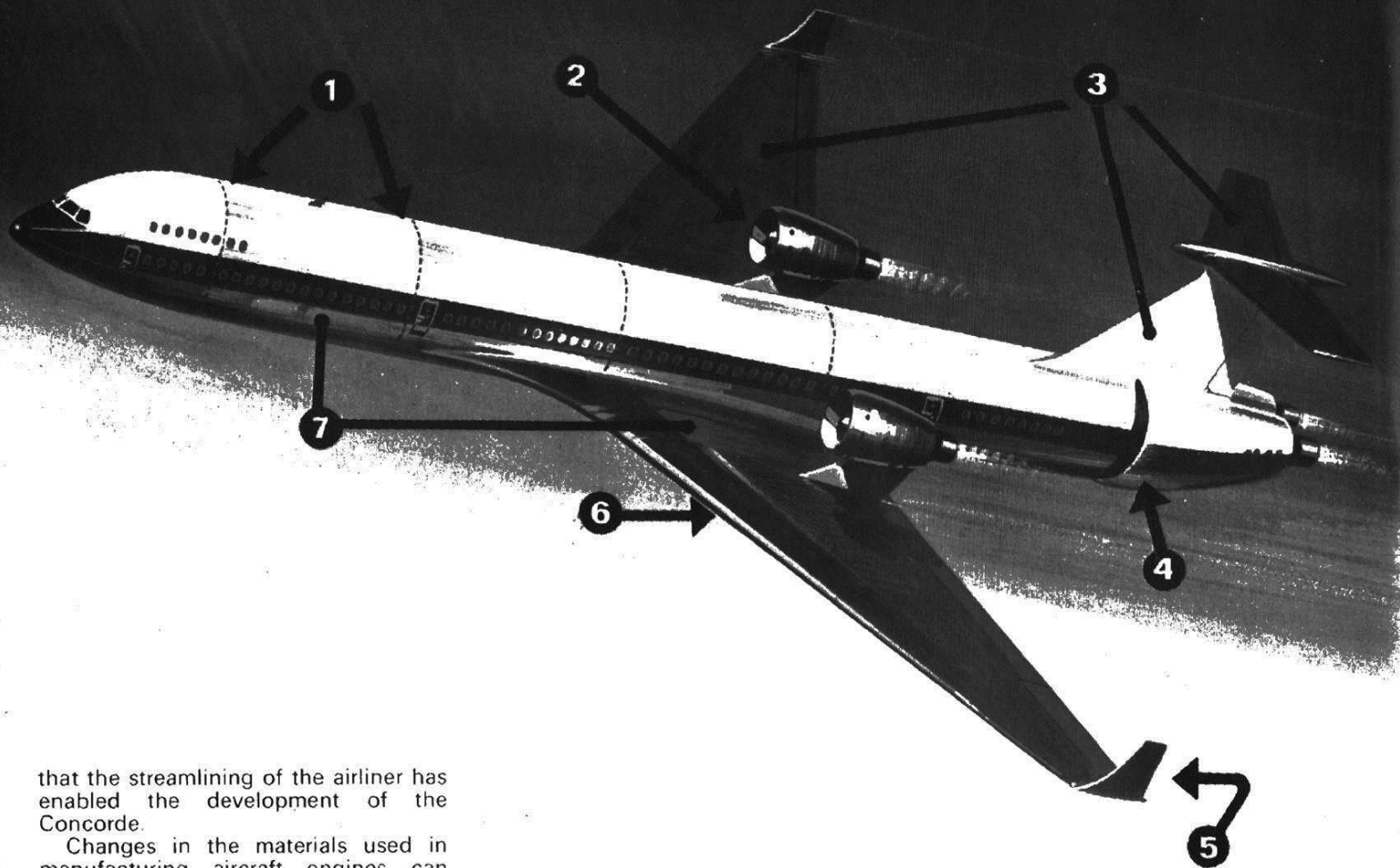
Bulbous Nose

For example, the more bulbous the nose of an aircraft—as in the Boeing 747 Jumbojet, for example—the greater the resistance it meets against the incoming air flow as it speeds through the atmosphere. The Concorde, with a very pointed nose and thinner wings

and fuselage, meets less resistance and—in addition to having greater power in its engines—is able to travel a lot faster using less fuel.

A 30 per cent fuel saving could be made by developing a system that blows air out of slots in the skin surface of the fuselage. This would reduce the drag caused by air turbulence round the fuselage. In a design produced by NASA, the United States Space agency, for such an aircraft, two of the plane's four engines are enclosed in the tail-end of the fuselage. Air diverted from the engine inlets provides the air-flow through the slots.

One of the American aircraft companies, Boeing, is working on the design of planes for 1985 to 2000. They are considering changes in wing-shape and engines—much in the way



that the streamlining of the airliner has enabled the development of the Concorde.

Changes in the materials used in manufacturing aircraft engines can effect a saving in fuel. In the Rolls Royce RB211 engine, used to power the TriStar, for example, a reduction in consumption of $1\frac{1}{2}$ per cent is possible by this means.

By using stronger but lighter materials—such as metal alloys containing a proportion of carbon black—the weight of the engines, and consequently of the aircraft, is significantly reduced.

America is studying the possibility of using nuclear propulsion, and aircraft using this may be flying by 1990.

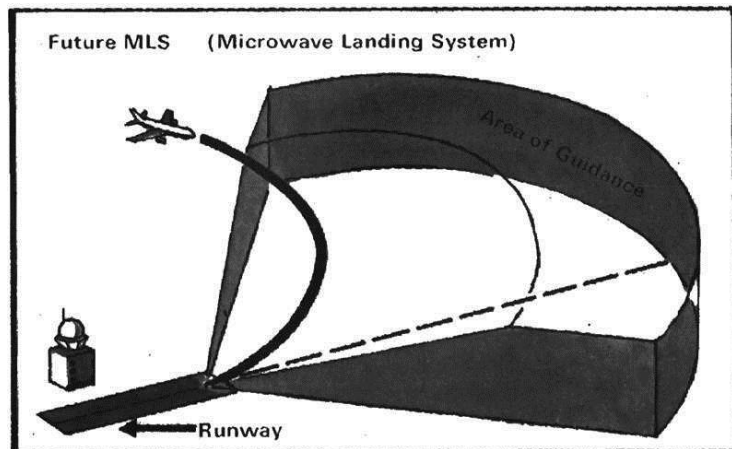
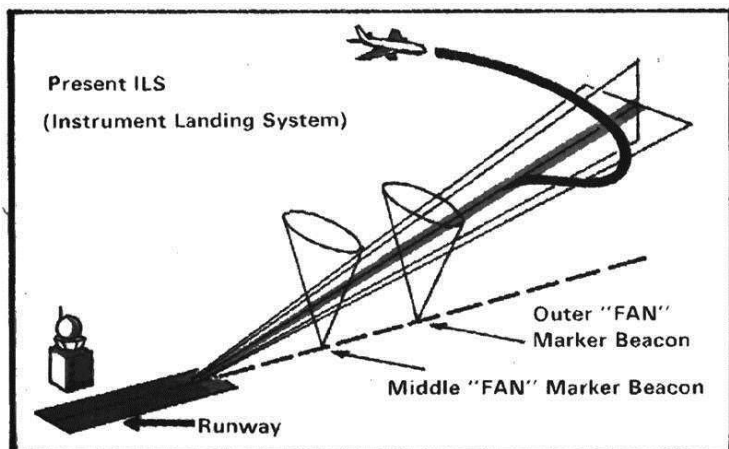
Liquid hydrogen as an aircraft fuel could provide a big solution to the

problems. A Jumbo jet carrying 113,000 kilos could, using liquid hydrogen, fly up to 6,300 miles. Liquid hydrogen is lighter than present day aviation fuel. The only problem is storing and carrying it. It has a temperature of -252 degrees centigrade and has to be stored under pressure, and this requires tanks three times heavier and stronger than present fuel tanks. But it would still provide savings.

So one day, it seems, instead of that humming Jumbo Jet you may be seeing something very different wheeling its way across the sky above you.

KEY

NASA-designed aircraft, using new fuel-saving techniques. 1. Slots in fuselage blow air down fuselage surface to smooth airflow; 2. Lightweight low noise-level engine nacelle; 3. Porous parts of wing and tail through which air would be sucked in to smooth airflow; 4. Air intake for rear engines which suck in air off the fuselage; 5. "Winglet", to smooth airflow and break up vortices from wing-tip; 6. "Supercritical" wing, designed to be ultra efficient just below the speed of sound; 7. Lightweight structure using new materials.



The problem of "stacked" aircraft—many planes waiting to land at one time—could be overcome by using an automatic computer-controlled Microwave Landing System (MLS: above right), instead of the ILS (Instrument Landing System) in use today (above left)

WORLD of WONDER BOOK

1975

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FLEETWAY
ANNUAL





WORLD OF WONDER BOOK

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THE REAL FLYING SAUCER

Several planes have been made by the Americans which closely resemble a Flying Saucer. The first was a plane called the Flying Flapjack (Bottom picture right). This appeared in 1942 and it had two piston propelled engines. It was replaced by the XF 5U 1, four engined aircraft with a maximum speed of 425 miles per hour. (Bottom picture left). This was abandoned because of the birth of the jet age, which has now produced the jet-propelled Zinnerman Flying Saucer, shown here.



THE ZINNERMAN
FLYING SAUCER



THE CHANGE-VOUGHT
XF5U-1



THE FLYING
FLAPJACK
V-173

“CONSHELF THREE”



Captain Jacques-Yves Cousteau of France, has for many years been studying life beneath the seas. He has built a sphere called the "Conshelf Three" which can be lowered to the sea bed. Underwater divers, called oceanauts, can live in the sphere for long periods. They study the fish and plant life around the Conshelf and can leave it, wearing diving suits, through a hatch. The sea water is kept out by the pressure inside the sphere. The men contact the headquarters on the surface by telephone and the people above can watch what is going on in the sphere by means of several television cameras, which are placed around the sphere. Medical experiments to see the effect of living under water are carried out on the divers in the sphere.

1. Commander talking to surface by telephone.
2. Test and Communications bench.

3. One of several T.V. cameras. All parts of sphere can be watched by H.Q. on surface.
4. Dining table.
5. Deep-freeze food store.
6. Spiral stairs to lower floor.
7. Diver preparing to leave by sea-hatch.
8. Bunk room. Laboratory also on lower floor.
9. Outside store for canned food.
10. Bag containing nine tons of water.
11. Legs supporting Conshelf on sea floor.
12. Ballast tanks. (On both sides).
13. Conshelf's emergency "lifeboat".
14. Power and communication cables to surface.
15. Capt. Cousteau's famous two-man "diving saucer", illuminating an under-sea oil well head suspended from a supporting balloon.

SR.N4 -

THE WORLD'S BIGGEST HOVERCRAFT



Britain has always played a major role in the long and exciting story of the sea. The new Hovercraft, the S.R. N4, carries on her tradition for engineering skill.

The Hovercraft is 130 ft. 2 inches long, and carries 254 passengers and 30 cars on its crossings between England and France. An all-passenger type has accommodation for 609 people. It travels at 70 miles an hour and makes the journey in about 35 minutes. On either side of the car deck are saloons with comfortable seats for all passengers who are able to gaze out through the large windows which extend the full length of the craft.

Inside the control cabin is a three man crew, a commander, an engineer and a radar operator who also acts as a navigator.

KEY TO CUTAWAY DRAWING

1. CONTROL CABIN WHERE SIT THE COMMANDER, RADIO OPERATOR/ENGINEER, NAVIGATOR/RADIO OPERATOR
2. RADAR SCANNER
3. MAST HOLDING NAVIGATION LIGHTS AND RADIO ANTENNA
4. CAR DECK TO TAKE 30 CARS
5. FORWARD CAR RAMP (LOWERED)
6. ANCHOR
7. PASSENGER CABIN VENTILATION INLET
8. FLEXIBLE NYLON-FABRIC HOVER SKIRT
9. 12-BLADE, 11½ FEET DIAMETER FAN BLOWING AIR INTO SKIRT FOR HOVERING
10. OUTER PASSENGER SEATING

11. MAIN PASSENGER ENTRANCE STAIRS
12. PASSENGER LOUNGE
13. SECTION OF SKIRT CUT AWAY TO SHOW PATH OF AIR FROM FAN TO HOVERSKIRT
14. ENGINE AIR INTAKES WITH FILTERS
15. TWO BRISTOL SIDDELEY MARINE PROTEUS TURBINE ENGINES EACH SIDE, DRIVING PROPELLERS AND AIR CUSHION FANS
16. DRIVE-SHAFT TO REAR PROPELLER
17. FOUR-BLADE, 19 FEET DIAMETER, REVERSIBLE PROPELLERS
18. REAR CAR DOORS (OPEN)
19. RUDDER
20. DRIVE SHAFT TO FORWARD PROPELLER
21. REAR CAR RAMP (LOWERED)



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